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- » Pain as an emotion
- » How your brain is holding you back
- » An amateur's descent into the madness...
- » The near-impossibility of the grand-tour double

VOL. 44/NO. 12
NOVEMBER 2015
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**PAIN IS IN THE EYE**
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This is Jeremy Powers. He is grimacing because he is in pain. His legs are on fire because he needs to be the first into the turn. He doesn't care how fast he's going. Not because he's crazy. But because he knows his ***SRAM HydroR*** disc brakes can help him to control his speed, no matter what. So Jeremy rides as fast as he can. Always.

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If you're just riding for mental health, physical health, fun or diversion, that's fantastic. But if you're "training," that four-word sequence up there in the headline is basically the way to improve. Each step in the sequence, crucial. However, we've noticed in the last handful of years or so that some of the ultra-serious and ultra-grumpy are acting as if there's another step. A step that says they have to act elitist. Snobby. Mean. Or downright rude. Well, here's the way we see it. After over six decades of doing this, we've learned that there's always someone faster than you. Yes, even you. And you also never know when injury or setback or just an off day can rear its ugly head. So let's all remember to mix a bit more humble into our program. Be good to each other out there.

ENDURE & ENJOY

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**THIS PAGE:** Chris Case
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# OFF THE FRONT

## TRIPLE RAINBOW

A 23-year-old with a diamond stud on her left incisor may be the greatest cyclist of the modern era.

Pauline Ferrand-Prévot became the first rider in history, male or female, to hold the world road, cyclocross, and mountain bike titles simultaneously when she won the cross-country title in Vallnord, Andorra, in early September.

After racing a road schedule all summer, Ferrand-Prévot started in the middle of a stacked field but quickly made her way into, and then passed straight through, the front group. It was a commanding victory, achieved with the air of ease brought only by cycling's greatest champions.

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# Moving ahead

IN LATE SEPTEMBER, a couple of weeks before we shipped this issue to the printers, I was at Interbike announcing that we are going back to calling this magazine *VeloNews*.

It's okay if you never took to calling it *Velo*. I didn't. A lot of people never even realized that the name had changed. The truth is that splitting our magazine and web brands (velonews.com never changed) wasn't the best idea. So we are going back to *VeloNews* for everything we do—the magazine, the website, our custom office socks. One brand, many platforms.

You'll notice, however, that the cover of the issue you're holding still says *Velo*. As part of this back-to-the-future rebranding, we're going to redesign both the magazine and our logo. That will take a few weeks, at least, and then a few more to reach subscribers and newsstands. (Such is the speed of print magazines.) But trust me: The change is coming.

Inside the magazine, we've already started mixing things up. Historically, *VeloNews* was a weekly publication whose raison d'etre was race reporting. We are and always will be race driven to our core. But as this magazine shifted from a weekly to a monthly a few years ago, traditional race reporting started to make less sense. With everything from the Tour de France to the Four Days of Dunkirk now available through livestreaming and reported within minutes online, a monthly print magazine has no business focusing on race reports.

Our website will still be the best place to go for up-to-the minute race coverage and breaking news from the frontlines of the sport we all love. But here in the magazine, we'll be focusing more on what print does best: in-depth profiles, beautiful photography, investigative features, race previews, and context and analysis that helps readers better understand the sport.

Those changes have already started. That's why our September cover was pegged to the world championships, rather than the Tour, even though that has historically been the issue in which we covered the Tour de France. It's why the October issue was all about setting the stage for the upcoming cyclocross season. And it's why the issue you're holding now is built around the timeless theme of suffering—something that matters to us as much on our trainers in November as it does on the cobbles in April and in the Alps in July.

Check velonews.com every day for race reports, breaking news, and product reviews. Read the magazine for everything else you love about this sport. They're two sides of the same coin. And now, once again, they're two extensions of the same brand—one that's been driving cycling culture in the U.S. for more than four decades.

— JOHN BRADLEY

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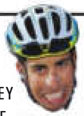
## WHO HAS THE BEST SUFFER FACE IN THE PELOTON?



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TIM DE WAELE (5); BRAKETHROUGH MEDIA

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As one hard-fought race season ends,
preparation for the next must already begin.
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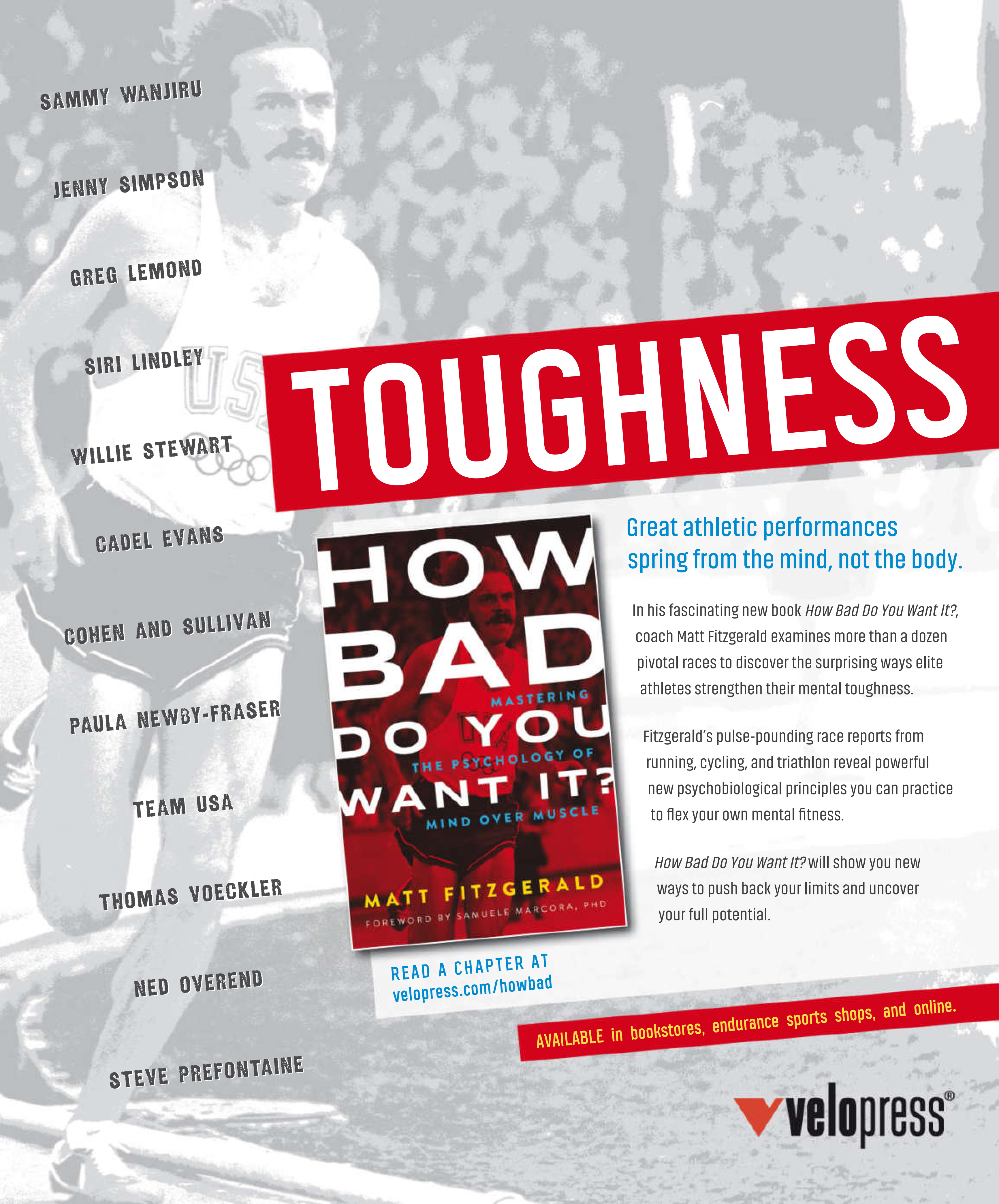

## Great athletic performances spring from the mind, not the body.

In his fascinating new book *How Bad Do You Want It?*, coach Matt Fitzgerald examines more than a dozen pivotal races to discover the surprising ways elite athletes strengthen their mental toughness.

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The inside line on the world of competitive cycling

# VELONOTES»

COR VOS

# Beast mode

## Peter Sagan delivers a world championship ride worthy of the rainbow stripes

BY ANDREW HOOD | RICHMOND, VIRGINIA

**AS A BOY GROWING UP IN A SMALL TOWN** in Slovakia, Peter Sagan loved superheroes. The Hulk. Superman. Wolverine. Their stories were his escape and fantasy.

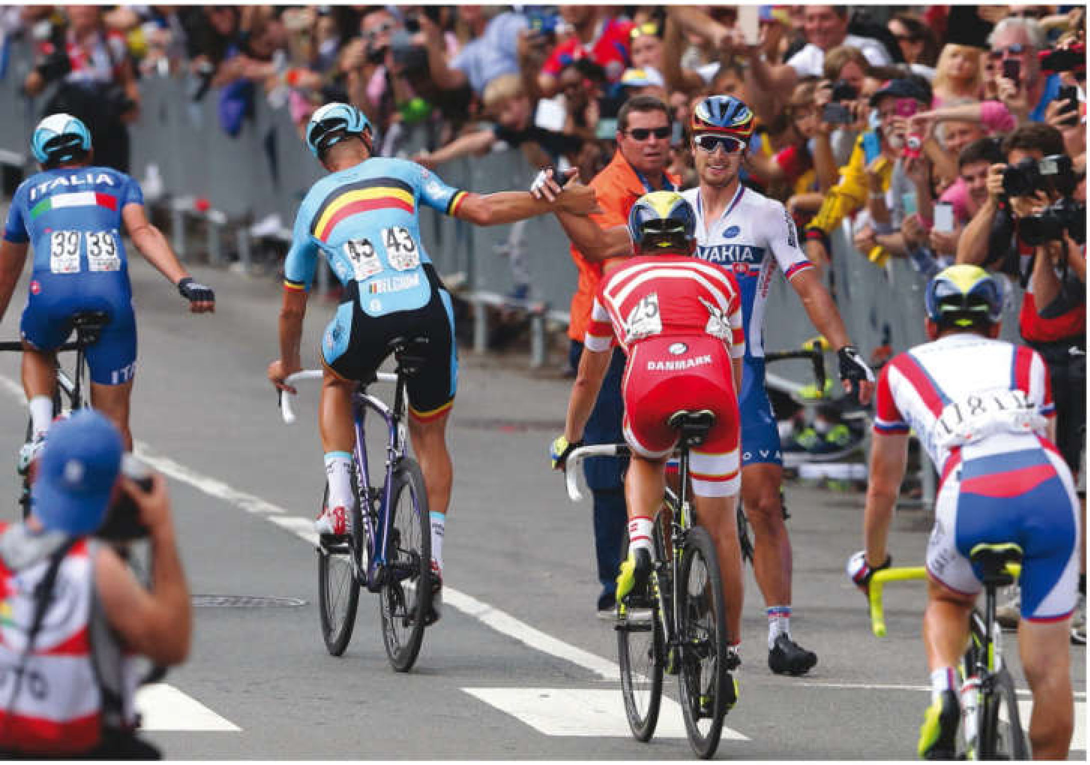
On a humid afternoon in Richmond, Virginia, a world away from the small grocery store his parents owned, Sagan transformed himself into a superhero, uncorking an all-or-nothing attack three kilometers from the finish line of America's second world championships. He turned himself inside out, squeezing his bulky build into a torpedo shape on the final descent, opening up a 13-second lead on a furiously chasing pack with 1km to go. The final 800-meter false-flat finishing straight became the longest, and most fruitful, in Sagan's young but prodigious career. All that was missing was the finish-line wheelie.

"The last 800 meters was very tough," Sagan said in his broken English. "If I look back or stop to pull and wait for the sprint, maybe I can get third or fifth."

After a season of second places—15 of them—Sagan was first across the line in the race that mattered most. At long last, he was the cycling superhero everyone expected him to be.

---

To understand the enormity of Sagan's world title, one must travel to Zilina, a quiet town of 85,000 in northern Slovakia, near the border of the Czech Republic and Poland. As the youngest of three children, Sagan was always causing



**RESPECT**
Sagan's victory wasn't popular with only fans. His fellow competitors were just as quick to congratulate him, with rider after rider giving him high-fives as they passed by.

TIM DE WAELE

“I don’t want to be the next Eddy Merckx; I want to be the first Peter Sagan.”

trouble. His dad, like any exasperated father might, tried to distract him. He eventually put him on a bike. That forever changed things.

“I like the bike. It’s like a game,” Sagan once explained. “I have fun on the bike. Even now, as a professional, I have fun.”

That game soon became his obsession. As a junior, Sagan raced mountain bikes, cyclocross, and on the road. And he was good—freaky good. (See YouTube for numerous examples.) That kind of enthusiasm for the bike, and his charismatic style off the bike, plays well with the fans—to the point that he could be the sport’s next crossover star.

“Peter can be a big star if he wants to,” says his agent, ex-pro Giovanni Lombardi. “He could be the Valentino Rossi of cycling. It all depends on how big he wants to go.”

The 25-year-old has the charisma, skills, and wins to be cycling’s next superstar. His rainbow jersey could push him over the top. The only problem he’s had up until now is the annoying media. Nothing ruins Sagan’s day more than being asked by a cigarette-smoking journalist when he’s going to win a “big one.” Richmond settled that once and for all.

Surprisingly, Sagan didn’t pop a wheelie when he crossed the line. That came later. What he did do was look back, perhaps in disbelief, and then walk back toward the line to celebrate with his rivals. Rather than complain of their mutual disappointment, his on-the-road adversaries seemed to revel in Sagan’s victory. Rider after rider high-fived him as they rode past. They shook his hand, patted him on the back, and smiled despite having just lost to him. That served as testament to the respect Sagan holds within the peloton.

“Sagan is a worthy world champion,” Taylor Phinney says. “He’s the first one we’ve had in a while who truly deserves it.”

Belgium’s Philippe Gilbert feels the same. “Sagan deserves to win,” says the 2012 world champ. “Everyone knows he’s a great rider.”

Even Oleg Tinkov, the outspoken Russian owner of Sagan’s Tinkoff-Saxo trade team, who complained all season about having overpaid for Sagan, gave praise, calling him “a beast.”

Sagan turned pro in 2010 and picked up his first pro win in just his second WorldTour event, at that year’s Paris-Nice. Since then, the expectations have mounted. Pundits called him the next Eddy Merckx, to which he famously retorted, “I don’t want to be the next Eddy Merckx; I want to be the first Peter Sagan.”

That label has been bandied about more than a few times. The weight of expectation was also hoisted onto the shoulders of Norway’s Edvald Boasson Hagen. But Sagan has delivered. The wins have come easily, with nearly 70 victories in bunch sprints, semi-classics, and stage races. He can win on any terrain—over cobbles, up climbs, down harrowing descents; there’s no rider as versatile as Sagan. Yet it seems like he got stuck in his quest for a “big one.”

After Tinkov made him a very rich young man (with a contract estimated at $4.5 million per year), Sagan got bogged down in 2015 with a string of second-places and close calls. The classics were a bust, and though the Tour de France was amazing for different reasons, he didn’t win a stage. When he was knocked out of the Vuelta a España after being hit by a motorcycle on stage 8, Sagan was unsure he would be ready for the worlds. He trained at altitude—in Utah, of all places—and came to Richmond with uncertainty.

“I was not sure I would have the legs,” Sagan said. “I went to altitude, I made the sacrifices, but I did not know how I would do.”

Neither did anyone else—not until the final lap at Richmond. Sagan had stayed hidden in the bunch, riding discreetly lap after lap, biding his time, waiting for the right moment. It was only on the final climb of 23rd Street—the short but very steep climb just after the climb of Libby Hill—when Sagan hit the accelerator.

It was a work of art: pure, unbridled racing. Sagan attacked at precisely the right moment. He opened a gap on a furiously chasing Greg Van Avermaet (Belgium) and Boasson Hagen, coiled up over his bike, and brilliantly rode everyone off of his wheel. He glanced once over his left shoulder and flashed down a quick descent and through a series of corners at a speed no one could match before hitting the red kite with a winning margin. Teams from Australia, Germany, Belgium, and Spain chased furiously, but Sagan held off the entire pack by himself. Even a pedal slip with 600 meters wasn’t enough to stop him.

“I’m happy to have one big victory like this,” he said with a wink. “I think the rainbow jersey is the best for me. Now I can stop my career.”

When the Richmond course was revealed, most people in the sport predicted Sagan would win. Yet if you listen to the new world champion, it was a surprise even to him.

“I couldn’t believe it. I crossed the line alone in first,” he said. “I wasn’t thinking about the rainbow jersey this year, and now I have it. Strange.”

That’s what superheroes do. They deliver the unexpected. Defy gravity. Smash through walls. The reign of Saganator has begun.

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# Ask a Pro

Deep philosophical advice from a roadie sage by Phil Gaimon

### I have a giant patch of road rash, and it's taking forever to heal. How does a pro handle an injury like this?

I wish I weren't such an expert in this department, but through a combination of personal experience and watching television, I'm sure I know enough to help.

❶ First, when you're lying there on the pavement, look around and figure out who's responsible. Who crashed with you? Can you blame them? Who was driving the motorcycle? Who put a dangerous corner in the race? Who caused it to rain? Who dug that pothole? Is your tire flat? Maybe it tore when you slid for 30 feet and rammed into a wall, but if there's nothing else, a flat can be a great scapegoat. Simply claim that you suddenly flatted in the middle of a corner. Nothing you can do about that, right? Just remember that a true pro never takes responsibility for a crash.

❷ After you get up and dust yourself off, wait for the cameras to crowd around you, appear calm and collected, and then hurl your bike into the woods! Your sponsors deserve this disrespect for making a product that's subject to harmful forces like gravity, friction, and momentum. Don't forget your helmet and glasses.

❸ Get back on the spare bike and hold onto the medical car as long as you need to while the race doctor cleans you up. You'll return to the pack completely cleaned and bandaged half an hour later, with one arm several inches longer than the other.

❹ I estimate that up to 25 percent of cyclists don't have a doctor in a follow car. When that's the case, I've been very successful at entering the shower—still wearing my torn and bloody kit—and scrubbing the hell out of my wounds with tons of soap and water using the chamois I'm about to throw away. If you want to be pro about it, also use a stiff brush, which basically grinds your skin away like sandpaper.

❺ To kill the germs, liberally pour various chemicals into the wound. (If it's not stinging, it's not working).

❻ If you're not crying yet, throw some of the chemicals into your eyes.

❼ While you're still in the shower, make sure you scream and groan in pain for anyone within earshot. That way it's clear you held it back for all those hours, and listeners will admire your strength and pain threshold while feeling sorry for you.

❽ Cover the wound with Tegaderm. It's expensive, but nothing else works on a large area. Everyone buys five different products for $2 each, throws them out, and then spends $6 on the good stuff. You should skip the first part.

❾ Now that you've had time to think about it, log in to your Twitter account and start publicly blaming the guilty parties.

❿ Inspect your helmet. If there's a crack in it, you need a new one. It's oddly satisfying to jump up and down on it, or run over it with your rental car. Have fun with it. Don't let that concussion sap your creativity!

⓫ If you're at a hotel, ruin the sheets and move on. If you're at home, keep a set of maroon ones in the closet for just these occasions.

*Phil Gaimon races for Optum-Kelly Benefit Strategies. His website is philthethrill.net.*

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# Suffer no more

## Cycling is hard, painful, challenging. But to be alive and riding has nothing to do with suffering.

By Ryan Newill

GRUBER IMAGES

**"SUFFERING": THE WORD IS ETCHED IN** cycling's lexicon, deeper, it seems, with each passing race and ride. The sport's relationship with suffering—the word and the state of being—predates the internet. But in the social media era, when carefully filtered images of abrasions, mud-streaked legs, and faces lined by fatigue can and must be dramatically captioned, its use as a descriptor of life on two wheels has exploded.

And why not? The word has always fit cycling's hardscrabble identity, one forged in the operatic newspaper coverage of those early Tours de France and Giri d'Italia. It fit perfectly into the narrative of *les forçats de la route*, the convicts of the road, grimly enduring all manner of hardships to escape the farm or factory life.

A hundred years later, it still applies. How else can you describe what Fabian Cancellara has undergone this season? One of the last great season-long campaigners, he cracked two vertebrae in a crash at E3 Harelbeke in March, then another two while wearing yellow at the Tour de France. He clawed back again to start the Vuelta a España, only to be felled by a virus. Spartacus called it a season in August, having struggled, endured, and, yes, suffered.

And what do you call Peter Stetina's experience since hitting an unprotected traffic bollard in a sprint at the Vuelta a Pais Vasco, where he shattered his leg, kneecap, and three ribs? On the bike, the 28-year-old helped his BMC Racing teammates win stages at August's USA Pro Challenge, his comeback race. Off the bike, he walked with a cane. You call that "suffering."

Those are extremes. But this sport definitely has a baseline level of individual affliction, the routine suffering we deliver to—and accept from—our rivals or force upon ourselves. The burning legs and searing lungs, the churning gut, the tunnel vision—all the manifold symptoms of the body running out of the materials it needs to do what the brain asks it to. In cycling, these discomforts are somehow a reward.

"I cannot sprint against the fastest, and sometimes I struggle on the bergs at Flanders, but Roubaix is perfect for me," Belgian brawler Stijn Vandenbergh said before this spring's Paris-Roubiax, perhaps the race most closely associated with physical torment. "I like to suffer and make others suffer."

In most contexts, that sentiment would mark Vandenbergh as a sociopath. In cycling, it's a testament to his dedication to his job. Indeed, if the sport's assorted gods assembled their own set of commandments, somewhere between Eddy Merckx's "ride lots" and Major Taylor's "don't eat cheap candies" would lie Udo Bolts' admonishment to Jan Ullrich as he struggled with a moment of weakness en route to his 1997 Tour victory. The hardened domestique's advice to his young charge offered neither tact nor tenderness: "Quäl dich, du sau!"

Suffer, you swine.

Bolts was nails—ask anyone—and while most of us won't stoically drag more fancied riders through 12 trips around France, there is a little bit of him in all of us. We are comforted by the fact that for all the affronts to our rights on the road, the hurled insults about Lycra and sexuality and more than a few hurled beer cans, the bad weather and popped collarbones and all of the other indignities of thousands of miles on the road, we are tougher than other people.

We suffer it all and smile.

We smile because cycling, lest we forget, is not the way of the cross. To focus solely on the pain and grimaces and raw, bleeding knees in all their romantic, sepia glory is to ignore cycling's inherent yin and yang, one that guarantees equal portions of not suffering—generous helpings of beauty, reward, and fun.

There is no other sport with such a refined balance, which offers so detailed a receipt of the physical currency spent and later refunded. Each leg-sapping ascent comes back to us on the downhill. Every too-hard pull on the front finds its counterweight in those seemingly impossible moments being sucked along at the back, spun out and effortless at the same time. Even the most relentless coastal headwind vanishes at the turnaround. (There are no tailwinds in cycling, as the saying goes. There's either a headwind, or you're having a great day.)

It isn't always that simple. Rewards for the harder moments aren't necessarily immediate. Winds that promised to pay us back on the ride back home can shift or die, and mountaintop finishes can deny the gravitational dividend. On every group ride and in every race, someone is stuck paying the bigger part of the peloton's collective tab. But over the years, it all evens out.

For all the howling winds and cold rains or, worse, winters spent in basements hunched over warped rollers, there are the bluebird days that can't be captured with a lens or improved with a filter. Terrible city streets and urban sprawl give way to smooth, rolling farm roads and high mountain passes. Every dizzying Wednesday interval session has its counterpart in a chatty Monday recovery ride.

And for all those intervals and other slights against our bodies—the fatigue; the rebellions of joints and muscles and organs; the failures of talent and genetics and, if we're honest, commitment—there are those moments when it all comes together. Sometimes through careful planning, sometimes almost by accident, we occasionally fall into that state of grace where gaps close by magic, hills flatten out, and competitors seem slower. No matter how much the speed and effort might still hurt, in those moments, we're not suffering.

Nor are we suffering after our rides, when we sit in the sun with friends we've made over the years or on a single ride—whom we have alternately vanquished and been vanquished by, attacked and nursed home. We drink coffee or beer and laugh at ourselves and our lives. We enjoy the still, satisfying fatigue that stems from the effort we just completed, of having emptied the tank and found out where the limit was.

It is the opposite of suffering.

There is true suffering in cycling, the kind that can't be relieved by simply letting up or putting a foot down, resting, and recovering. You can see it in the sad journeys of the sport's troubled souls, men like Marco Pantani, José María Jiménez, and Frank Vandenbrouke, and in the anguish of the families of Nicole Reinhart, Andre Kivilev, Wouter Weylandt, Fabio Casartelli and all the others who went out one morning to race bicycles and didn't come back. It is there in abbreviated careers of men like Mauricio Soler. But that suffering—that of lives profoundly changed or lost—is the suffering of humanity. Cycling is only the setting. The kind of suffering cyclists talk of when we recount how the road pitched up or the big attacks went down? That isn't suffering at all. It is discomfort, pain, or an investment that pays off later, in the next race, on the other side of the hill, on the ride back home, or in a warm coffee shop after a cold January ride.

Call the sport "hard" or "challenging" or "painful." It is all of those things. But don't ever describe being alive and able to ride a bicycle as "suffering."

*Ryan Newill has contributed to Velo since 1999. Follow him on Twitter @SC_Cycling.*

GRUBER IMAGES; TIM DE WAELE (3); HARRY HOW/GETTY IMAGES

# WINNING

### PEOPLE'S CHOICE

Peter Sagan stops the criticism with one vicious attack, taking a popular victory in Richmond that even rivals like Tom Boonen could appreciate.

### LUCKY NUMBER FIVE

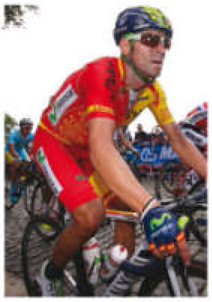
After five consecutive podium finishes at time trial worlds without taking gold, Linda Villumsen finally takes the title.

### TIME MACHINES

American juniors take four out of six medals in the time trial at worlds, with the junior women going one-two in the TT and road race.

### ETERNAL CONTENDER

With the exception of two low placings in 2007 and 2008, Alejandro Valverde has no fewer than nine top-10 finishes to his name since his worlds debut in 2003—but no wins.



### THE NEW WILD WEST?

Of the 1,033 professional cyclists in the sport's Registered Testing Pool, the list from which biological passport testing is drawn, just over six percent are women.

### REVERSE COURSE

Allie Dragoo loses her chance to ride in the women's worlds road race after her trade teammate Lauren Komanski petitions USAC's selection committee and wins.

# LOSING

"The big countries can do some strategy. I'm no good at strategy. I can just do what I did."

— Peter Sagan, on his win at Richmond worlds

"It is hard not to be active when you hear the ground shaking with the words U-S-A."

— Alex Howes, on the tactics of Team USA, after he finished 12th at Richmond worlds

"Peter is the beast! Cycling without him would be different!"

— Tinkoff-Saxo team owner Oleg Tinkov after his rider, Peter Sagan, won worlds

"The temperatures will be a little warm in October. We are taking extra precautions. We'll have extra water."

— Sheikh Khalid bin Ali Al Thani, chairman of the 2016 World Road Cycling Championships organizing committee. Average October high temperatures in the Doha area run between 93 and 104 degrees Fahrenheit.

"Sure, we had our moments when we butted heads, but we've both grown up a little bit."

— Tyler Farrar, on the news that Mark Cavendish would be joining him at what will become Team Dimension Data in 2016

BRAKETHROUGH MEDIA; CASEY B. GIBSON; KARIM JAAFAR/GETTY IMAGES

# DESIGNED FOR YOUR JOURNEY

The Critérium du Dauphiné is considered by many to be one of best indicators of Tour de France success. Raced across many of the same roads it is a test not only for riders but also the equipment. Victory here can be a stepping stone to glory in July. The Cofidis Pro Cycling Team will be conquering those roads aboard the Kenda Kountach Endurance and Kriterium Endurance tires. Dual layer puncture protection and race tuned rubber compounds take the fear of the away, leaving the rest up to you . . .

CRITÉRIUM DU DAUPHINÉ, STAGE 2

COFIDIS PROFESSIONAL CYCLING TEAM

NACER BOUHANNI

KendaTire.com

KENDA

# WINTER WARMERS

## When the mercury plummets, turn to these gloves for the best in digit protection

By Dan Cavallari, Kristen Legan, and Spencer Powlison | Photos by Brad Kaminski

With the growing popularity of cyclocross, fat bikes, and other cool-weather excursions, the cycling season never stops. In the face of wet winter weather, it's no longer enough to simply insulate. The best gloves are sophisticated equipment, with waterproof fabrics that keep precipitation from chilling your skin, windstopper fabrics to help maintain dexterity, breathable membranes that ensure your sweat doesn't work against you, long cuffs for layering efficiency, and palm construction with strategically placed padding and reinforcement.

### ENDURA WINDCHILL GLOVE **$45**

★★★☆☆

Cyclocrossers, this thin and tough glove is made for you, but only when the clouds aren't spitting rain. While it's windproof, it's only water-resistant—not waterproof—which is great for light precipitation but not ideal when things get soupy. They fit snugly, thanks to the nylon-polyester-elastene construction that conforms to your hand and stays in place when you're transitioning the bike onto your shoulder. Unlike a full winter glove, the Windchill's cuffs are fairly short, so there's a possibility of a gap between your jersey sleeve and the glove itself. The palm is lightly padded with gel zones, strategically placed over key pressure points for a comfortable grip. Consider this a minimalist glove for cold but generally dry races.

### RAPHA WINTER GLOVES **$120**

★★★★☆

As a rule, cycling gloves get trashed, especially the kind that are worn on long, dirty winter rides. That fact alone makes it a little tough to justify the $120 price tag for this pair from Rapha. However, if you're doing major miles in cold weather, the dexterity afforded by the Winter Gloves' trim fit, combined with the soft insulation and windproof shell, is invaluable. We also liked how the goatskin leather palm broke in after a few weeks of riding, further improving fit. Beneath that leather, the heel features high-density padding. Some will like that cushion, but others won't, especially those who prefer the feel of thinly wrapped handlebar tape. The extended wrist protection tapers to block any drips that may stray down your arms toward the gloves.

### ASSOS BONKAGLOVE_EVO7 **$139**

★★★★☆

Assos's airBlock technical fabric, found on the back and thumb of the bonkaGlove_evo7, fends off wintery winds without excess bulk. These snug-fitting gloves are water-resistant (but not waterproof) for moderate moisture protection. Put your hand down in a snow pile and you'll be fine; dunk it in a mud puddle and you'll come up damp. The glove's textured fingertips and palms grip solidly on brake levers and handlebars, and the overall slender cut, particularly in the fingers, allows you to easily open gel packets or find a bar in your back pocket. The long neoprene cuffs are thin enough to layer under your jacket sleeve and offer extra wind protection right where the breeze likes to sneak in. Pull-tabs at each wrist are a nice touch for pulling the gloves on. All this technology comes at a hefty price, however.

### LOUIS GARNEAU PROOF **$65**

★★★★☆

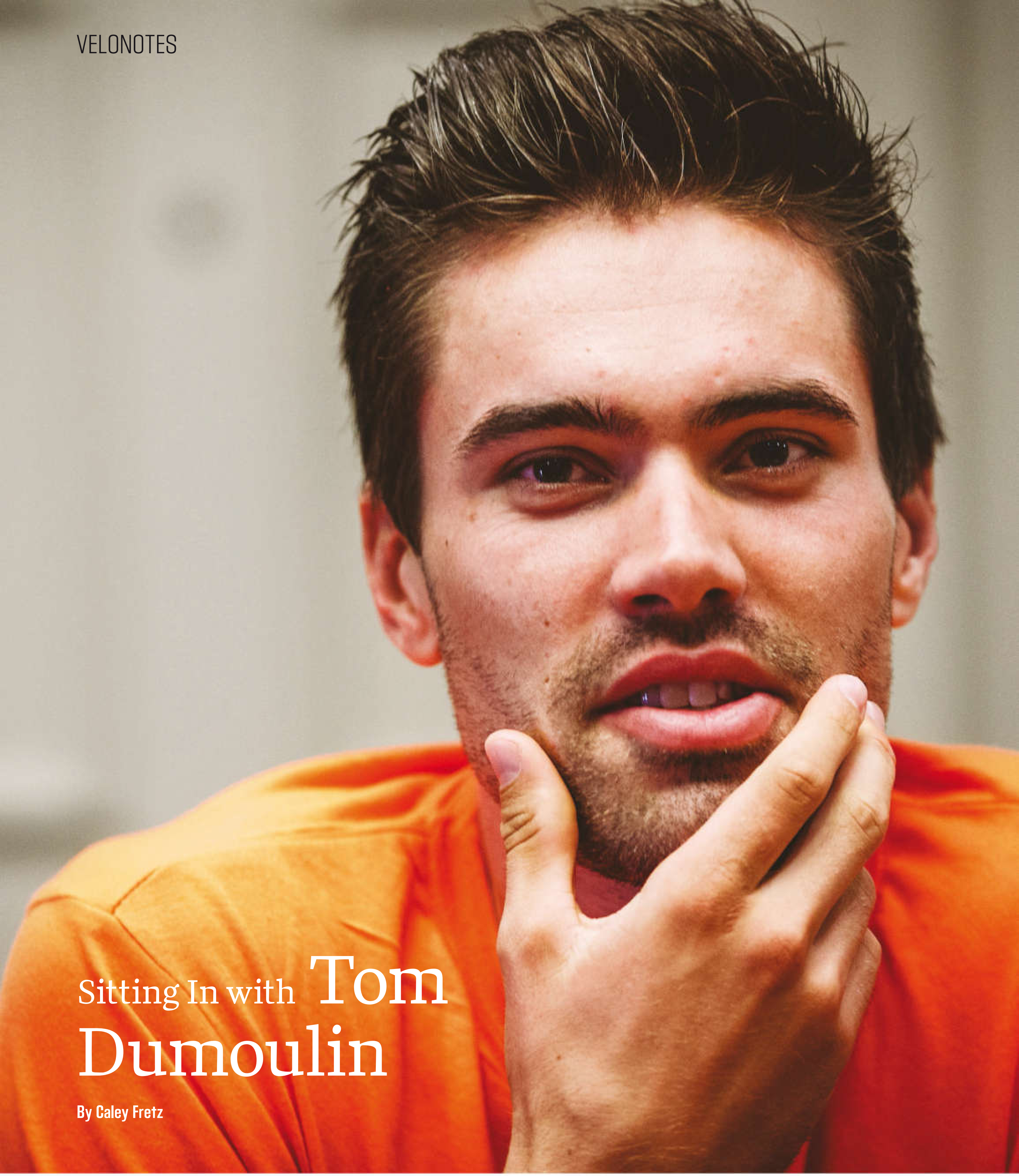
While it's probably a little too thin for the deep freeze of winter, the 40-gram Thinsulate insulation of the Proof gloves is ideal for shoulder season rides. A long inner cuff tucks neatly into your jacket sleeve to keep that pesky breeze out, and though the Velcro strap is probably extraneous—the outer cuff should be loose enough to go over your jacket sleeve—it's nice to have the option to tighten the cuff if you need to batten down the hatches. The slender design allows for comfortable hand articulation around the handlebars, and the touchscreen-compatible fingertips let you check your smartphone without exposing your bare hands to cold temps. 'Cross racers, don't fear the mud and rain; the Proof kept us dry in our completely non-scientific, dip-our-hands-in-cold-water test. A moderately padded leather palm stands up to the rigors of twisting and turning in race conditions—we really like the grip when grabbing the down tube during a run-up—and there's a vent in the center of the palm, presumably for moisture management.

2015 velo EDITORS' PICK

★★★★★

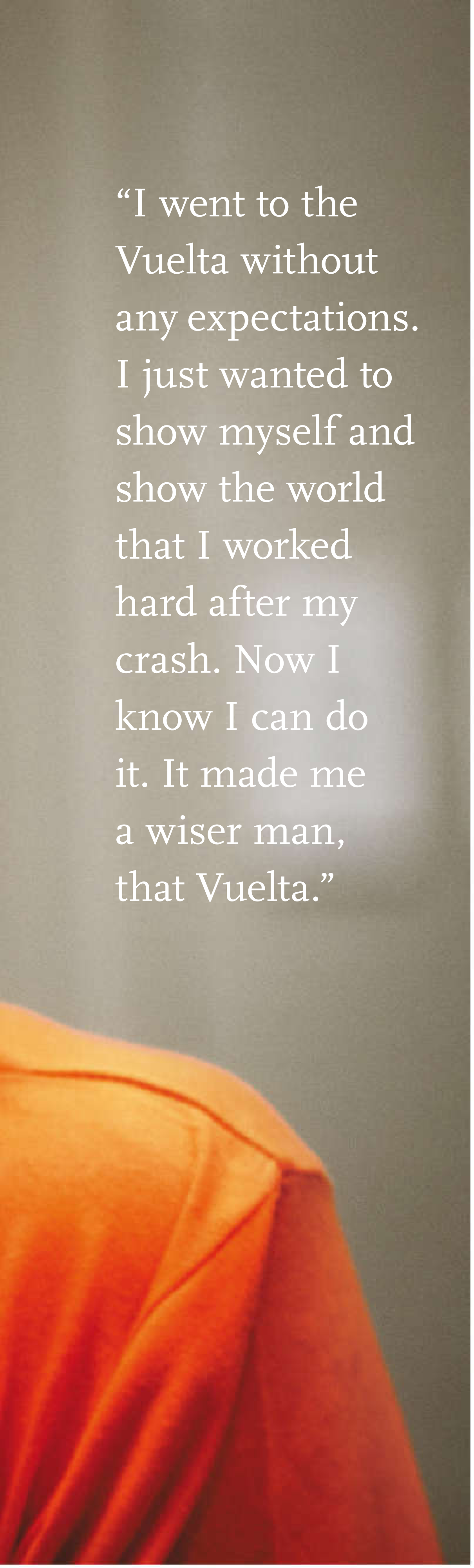
### GORE ROAD GLOVES GTX $80

Getting the best glove is good; getting the best glove at a reasonable price is even better. Gore's Road Gloves GTX pack a lot of winter protection into a modest price point. The Gore-Tex construction is designed to keep water out while allowing perspiration to breathe away from the skin. The glove is windproof, too, which is vital on high-speed descents where the chill of winter is likely to bite hardest. A slender cut leaves plenty of mobility for grabbing your brake levers, and the thin, ergonomic palm stays taut to avoid bunching when grabbing your bars. For such a low-profile glove, it packs plenty of warmth without the bulk, and the extended cuff protects all the way over your wrist. While the wrist opening could be a bit larger for allowing the glove to fit over a jacket sleeve, the velcro strap is ideal for tightening the cuff over a jersey.



# Sitting In with Tom Dumoulin

By Caley Fretz



“I went to the Vuelta without any expectations. I just wanted to show myself and show the world that I worked hard after my crash. Now I know I can do it. It made me a wiser man, that Vuelta.”

BRAKETHROUGH MEDIA

AFTER TOM DUMOULIN’S near miss at the Vuelta a España, a result that surprised him as much as anyone else, the young Dutchman’s career trajectory is very much in flux.

Conventional wisdom held that Dumoulin was too tall to climb, too thin to time trial, and too young to lead a team. That quickly fell away in Spain. Yet nobody really knows how far he can go, what he can make his body do, or how effectively he can tune it to varying athletic pursuits. His is now a career pulled by conflicting goals—stage races or time trial dominance, Tour de France or the Rio Olympics—and, after the Vuelta, redirected by incredible results.

The Dutchman sat down with *Velo* to describe his path forward and help illuminate the one he’s ridden until today.

---

**You seem to be a rider in the Bradley Wiggins or Miguel Indurain mold. Do you use them as models?**

I look at other riders and try to learn from them. If I could be as skinny as Wiggins and still ride fast, then why not. But it’s not like I want to be Wiggins or Tony Martin.

**How did you start riding?**

By coincidence. I was always playing football, and I didn’t like it anymore. I was looking at options; I liked sports, and I needed a way to get my energy out. I tried track and field, but I only like running, and they kept trying to make me jump and do other things, and I didn’t like that.

**By European standards, you came late to cycling. You were 15.**

A lot of riders start competition at 15 or 16, but they had ridden with their dad since they were eight. I’d never ridden my bike before I was 15. I’m 24 now, so I have nine years on the bike. At this point it doesn’t matter if you started at 15 or eight.

**Did you gain a bit of freedom by coming to the sport a bit late?**

I think so. To me, cycling is something that I love to do and that I will love to do over the coming years. If it all ended, I would be devastated, but I would find another life. It’s not like I’m lost without a bike. I really love it. But if I don’t ride my bike for three weeks in the off-season, I’m okay with that. I don’t get grumpy in the off-season without a bike.

**Do you have to love cycling to be a pro?**

Riding is a lot of fun. If it felt like a job I wouldn’t be doing it. Or maybe I would be, but I couldn’t do it like this. If you’re going for the top results in any sport, but especially in cycling, you have to make a lot of sacrifices. That’s only possible if you really like it.

**Without your Tour crash, would we have seen you as a grand tour contender in France?**

No, I don’t think so. I think my weight was a bit lower at the Vuelta than at the Tour, and my form was a bit better too. If you look at the first [Tour] time trial in Utrecht, I don’t think I would have done that better with Vuelta shape. But my climbing and my recovery were a bit better at the Vuelta.

It was never the plan to race for GC at the Tour. But it wasn’t the plan at the Vuelta, either. So, you never know.

**So the Vuelta was a surprise then?**

The Vuelta was quite a surprise to me. The idea in this part of my career is to finish a grand tour every year to just make me stronger. That was the idea for the Vuelta. I prepared well. I went to altitude again, and I trained pretty hard. But I went to the Vuelta without any expectations. I just wanted to show myself and show the world that I worked hard after my crash and that I was still motivated for the last part of the season.

Now I know I can do it. I know how I trained before the Vuelta, how to watch my weight. There are things I learned for the future. It made me a wiser man, that Vuelta.

**Will your team provide more climbing support next season?**

Well, they said they will. Already before this Vuelta that was the plan. In the future, the team will have a goal of keeping the sprint and leadout but also looking at support for me and Warren Barguil. He almost did a top 10 at the Tour, and I did top 10 at the Vuelta. We are both young; we’ll continue to develop. The team sees that. They acknowledge that we need a bit more support in the mountains.

But I won’t always target the general classification. I’m starting to get really comfortable with this time-trial trick. I know how to be aerodynamic, where to push the power on the course, where to take my recovery. I know how to take the corners. I’m getting better.

BELL
BELL
VLAB
PANACHE
FELT

# AMATEUR HOUR

For our brave test subject, the "hour" proved to be the ultimate laboratory for testing the potential of man and machine—and the quickest path to hurting like never before

BY CHRIS CASE | PHOTOS BY BRAD KAMINSKI

**I MIGHT BE DYING.** The corners of my vision are turning dark, vignetted like an old photograph. Someone, or something, seems to be persistently pushing the front of my head downward, and my neck muscles no longer have the strength to fight back. I have a sickening feeling of panic inside.

*I can't do this anymore. I don't know how I'm going to do this anymore. I can't do five more minutes.*

"Ten more minutes, buddy. Come on! Up! Up! Up!" come the yells from my pacer, mechanic, and friend, Nick Legan, at trackside.

*Oh f***, did he just say 10 minutes? I really, really thought he was going to say five. Oh f***.*

I'm at the absolute bottom. A feeling of deep despair sweeps over me. I feel so alone.

But none of that matters now. I am in the midst of indescribable agony. The black line is wandering beneath my wheels. My head keeps dropping further, more frequently. "Fast feet, fast feet," I repeatedly hear on the exit of turn two. The clinking, clacking of cowbells ring in turn four. My brain is only absorbing a fraction of these sporadic sensations. All I want is to rest my head.

*It's getting dangerous out here. I might crash; I could very well crash. I can't control this bike anymore, especially not while steering with my elbows.*

Instead of looking 10 feet ahead, I'm staring over the tip of my nose. All I see is a blur of sun-soaked grey. I'm hearing the yells to hold the line, stay smooth, keep my form, but I'm having irrepressible and involuntary urges to sit up. Something inside is driving, but it doesn't feel like it's me. I'm angry because I'm not in command. I'm scared because I'm out of control.

And then the gun goes off. It's over.

"Head up! Head up!" yell fans and friends trackside. I am depleted, destroyed (in retrospect, I think I might have been about to blackout) and heading straight for the lap counter at the edge

**FINDING TIME**
Colby Pearce worked with the author to refine his time trial position, a process that started from scratch, given Case's limited experience in the discipline.

of the track at almost 30 miles per hour. I correct myself as I wildly veer away from the infield wall, back up the steep banking of the first corner, then down to the blue apron of the track again.

I'm alive. I don't fully believe it yet, but it's all over now. There aren't enough expletives to describe what I was just able to do to myself while riding in circles, pushing as hard and as fast as I could with every atom of energy in order to finish right back where I started.

That's the hour.

I had volunteered for this misery. And for what? The pleasure of telling this story. I'd never ridden on a track before. I'd completed one time trial in my life in the aero position. I figured this was going to be amazing fun. And it was. Until it wasn't.

Cycling is a sport for geeks, nerds, and science-loving athletes. At its best it is a perfect blend of machinery and man. The ultimate expression of that symbiosis? The hour.

"It sounds cliché, but it's so pure," says Colby Pearce, who established a new U.S. national hour record in 1995, during the anything-aero days, at 50.191km. "It's the purest effort. It's just you going in circles. And there's something very, very challenging about that. It's so cool."

(So cool that Pearce has since ridden the hour twice more. He attempted to set a national record in 2013, falling short but hitting 49.806km, which established a new 40–44 masters record. The following week, having not had enough pain, he set a U.S. Merckx-style record of 46.452km.)

It is easy to become obsessed, tweaking every detail in an attempt to wring seconds and centimeters out of a stone. The best approach is through trial and error—experimentation and repetitive test rides after subtle changes to a slew of variables.

"I was surprised at the magnitude of this attempt, because I have done many, many track events," says Kevin Nicol, who attempted to break the 45–49 masters national record last September. He came up just short, after years of research and preparation. "I felt very green when I was going into this. It was a very daunting learning process. And everybody has advice. You have to take this advice and sift through it to what is applicable."

What is applicable? Aerodynamics, of course, of bike and body. Friction is a big one, both within your drivetrain and hubs and between tire and track surface. Psychology plays a massive role in helping you ride to your potential. Ultimately, it is a pure test of your threshold physiology. And then there's everything in between.

Only with fanatical analysis, in combination with an understanding of the constraints of the individual, will you find ultimate speed.

*I think I went out too fast. But that's okay. I can't go back. Just look forward. The data says this is sustainable. I believe that. God, this doesn't seem sustainable. That point of horrendous pain that everyone talks about is right here.*

The hour is the ultimate threshold effort. There have been volumes of journal articles written about what that actually means, but for the purposes of this article, it is the point in one's power profile where there is a rapid rise in lactate. This break point, caused by an imbalance between production and clearance in the blood, is often the number bandied around as the power you can hold for an hour.

Neal Henderson, an associate trainer with BMC Racing, coaches Rohan Dennis and worked closely with the Australian before his record-setting effort in January. His training advice was very simple: "If we are trying to simulate a reuptake, instead of plugging the system and going over, we stay just under, near that maximum clearance rate. So doing your efforts specific to the hour right at 90 percent of threshold is going to be better than at or above threshold, because you can recover from it more quickly and you can progressively build the volume of training there."

Once you know what power you can sustain for an hour, you can determine the speed you should expect to go (see page 29). If you know your speed, you can determine your gearing. The right cadence can make or break your attempt.

According to Henderson, there have been very few instances in the past 100 years when someone completed the hour with an average cadence of less than 100 rpm, including Chris Boardman in the superman position and Mathias Brändle, who averaged 99rpm in October 2014. Most average about 105rpm.

"There are a lot of reasons for this. If we look at the physiology, the force production of pushing a big gear can start to preclude blood flow, so you are actually not getting all of the blood in and out of the muscle, which is not a good thing," Henderson says.

Evidence suggests that for the same power output, higher cadences not only make for better muscle blood flow but also reduce muscle strain, making for better endurance.

*That first 30 minutes didn't feel as good as it did in my last training session. That's not good. Forget it. Move on. Keep the feet moving fast. Stay over that gear, find the arc in your stroke, and repeat it, repeat it. Shrug the shoulders, tuck the head, forget about time and place. Break it down into small chunks. Just ride. One more lap down. One more lap down.*

When I first spoke with Henderson about my hour attempt, and the effort in general, his initial reaction was, surprisingly, not about fitness, aerodynamics, or pain.

"Half of this is going to be about getting your head ready for it," he said. "No matter what, if we got you incredibly fit, but your head isn't in it, you would not access that capacity. This will ultimately reveal what you can or can't do. Your head will drive what is possible."

This is an often-neglected aspect of performance. When you consider the solitary, painful, and repetitive effort of the hour, the psychological hurdles are harder to overcome. Anyone who attempts it will do so virtually blind, having never, or very rarely, done it before. How hard can I realistically go? How will I react when I start to crack? Will I get bored going in circles?

Pearce, on the other hand, has gone through the training and the effort at least three times. He offers insight that very few people have.

"The thing about the track is that time stops," he says. "If you think that your biology class in

ILLUSTRATION BY HEIDI CARCELLA

# THE FORMULA FOR SPEED

**"TRACKULATOR"**
Check out the online tool that will do the math for you, so you can ignore everything on this page:
**analyticcycling.com**

## WATTS = $0.5\rho CdAv^3$

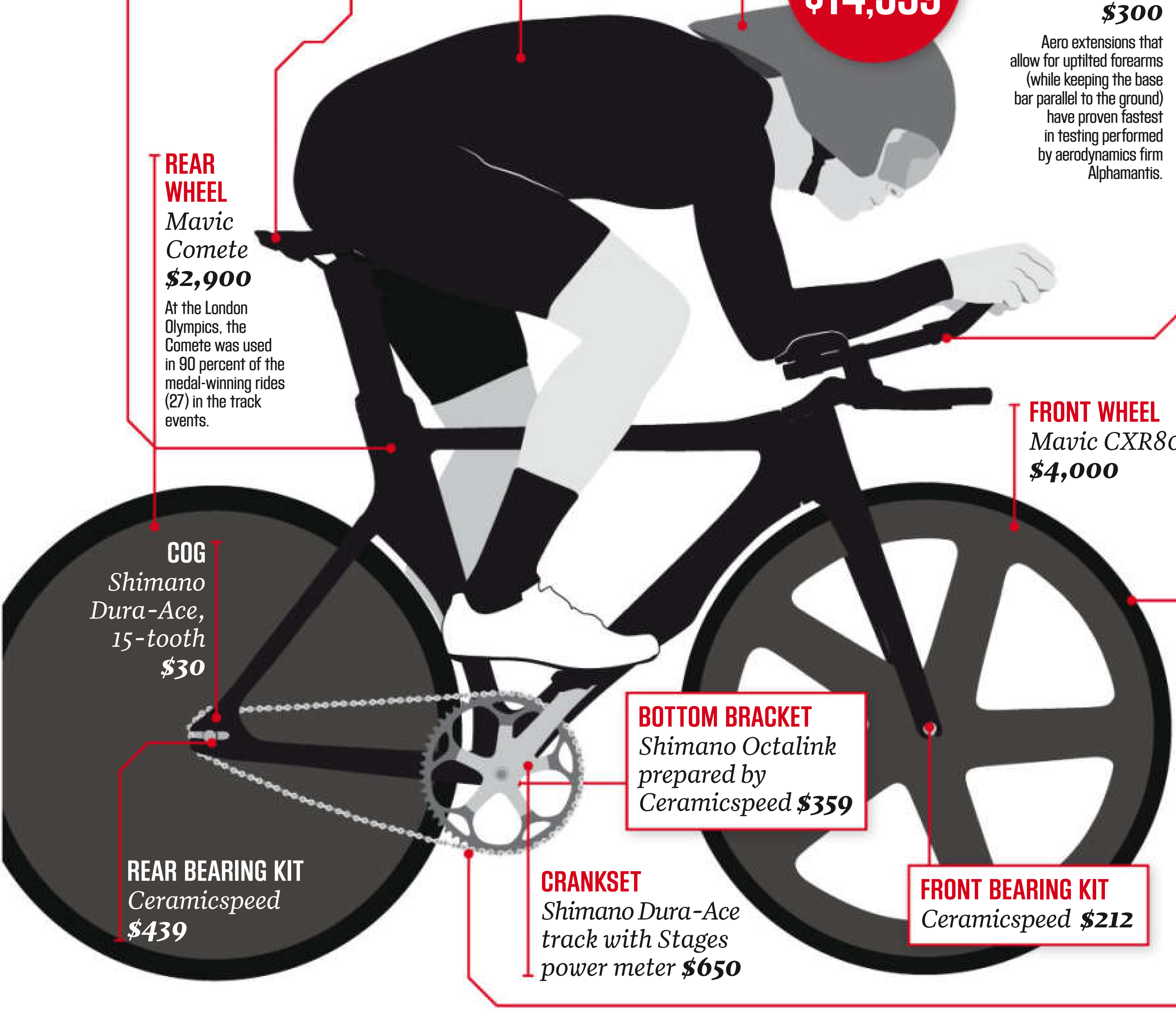
Want to know how far you can ride in an hour? Brush up on your math. It all boils down to aerodynamic drag and the above formula. $v$ is your velocity. $\rho$ is air density, which varies with barometric pressure, humidity, and temperature, all of which are influenced by altitude. $Cd$ is the coefficient of drag. A soaring eagle has a great $Cd$. A brick doesn't. Humans are more like the brick. Finally, $A$ is frontal area.

## FORCES AGAINST YOU

About 90 percent of your aerodynamic drag is a function of pushing air out of the way of your body. Aero gear will help, but for the most part, humans are bad at cheating the wind. What you can alter is how much is hitting the wind, by changing your position. There's a great primer on using Photoshop to calculate your frontal area here: cyclingpowerlab.com/CyclingAerodynamics.aspx.

## THE BOTTOM LINE

A cyclist isn't a formula. It's hard to predict how your body will work while contorted—at threshold, for an hour. Tweaking your bars by five millimeters to reduce frontal area by $0.01\ m^2$ might improve the math, but it might also result in rocking shoulders or a loss of power due to poor hip angles.



**TOTAL COST**
**$14,359**

### FRAME
*Felt Tk FRD*
***$4,000***

A frame with a low stack height allows for separation of rider and bike at the arm pads, which yields cleaner air flow over the core of the bike.

### SKINSUIT
*Panache V-lab* ***$475***

### HELMET
*Bell Javelin*
***$200***

Air that becomes turbulent behind a rider's helmet isn't flowing as quickly as the air in front of it. This creates a pressure difference and, therefore, drag, effectively pulling the rider backward.

### SADDLE
*Pro Aerofuel TT* ***$200***

### AEROBARS
*Felt Bayonet 3*
***$300***

Aero extensions that allow for uptilted forearms (while keeping the base bar parallel to the ground) have proven fastest in testing performed by aerodynamics firm Alphamantis.

### TIRES
*Challenge Pista Seta*
***$320 (2)***

At a speed of 50 kph, the best and worst tubular track tires can mean a difference of between 7 and 10 watts.

### REAR WHEEL
*Mavic Comete*
***$2,900***

At the London Olympics, the Comete was used in 90 percent of the medal-winning rides (27) in the track events.

### CHAINRING
*Shimano Dura-Ace 7710, 54-tooth*
***$135***

With a 54x15 gear ratio, at a cadence of 100rpm, on a 23mm tire, a rider will travel 45.335 kph; at 105 rpm, 47.588 kph

### FRONT WHEEL
*Mavic CXR80*
***$4,000***

### COG
*Shimano Dura-Ace, 15-tooth*
***$30***

### CHAIN
*Shimano Dura-Ace 9-speed prepared by Ceramicspeed*
***$139***

The right chain can save you at least five watts when pushing 250 watts. That's two percent and could mean the difference between a world record or a painful waste of an hour.

### BOTTOM BRACKET
*Shimano Octalink prepared by Ceramicspeed* ***$359***

### REAR BEARING KIT
*Ceramicspeed*
***$439***

### CRANKSET
*Shimano Dura-Ace track with Stages power meter* ***$650***

### FRONT BEARING KIT
*Ceramicspeed* ***$212***

high school was boring…16 laps is an eternity. Two hundred and seven laps is eternity squared. It is insane. Mentally, it will change your game. And that's cool, because it readjusts your perspective."

When working to prepare Dennis for his attempt, Henderson had the Australian watch at-speed point-of-view video of the track. It nearly cracked Dennis.

Accept that you will hurt. Everyone who does this has a tale to tell of excruciating pain. "It might not have been the most painful, but it was still right up there as one of the worst experiences on a bike that I've ever had," Dennis says. Knowing what will happen is enough to scare some people away. Others see it as an opportunity to prove something or, as Pearce noted, discover something new.

*This is a type of hard I've never felt before. Why is it so damned hard? What can I do? It's almost over. It's only an hour. Keep your head up, lift your eyes, don't let go. Keep the pressure on. Relax, inhale, exhale. Fast, but not too fast. Remember all the sensations from training and channel them now. You're almost there. Yes, you're almost there.*

---

When you think about the hour, you likely conjure up images of Graeme Obree on "Old Faithful," the bike he made in his garage from washing machine parts that initiated a flurry of dramatic positional and aerodynamic changes in the way competitors rode a bike. Along with the eccentric Scotsman, Chris Boardman revolutionized the hour. But it was not to last. The UCI had enough of their tinkering, their "superman" positions, and their futuristic bikes. The hour went dormant.

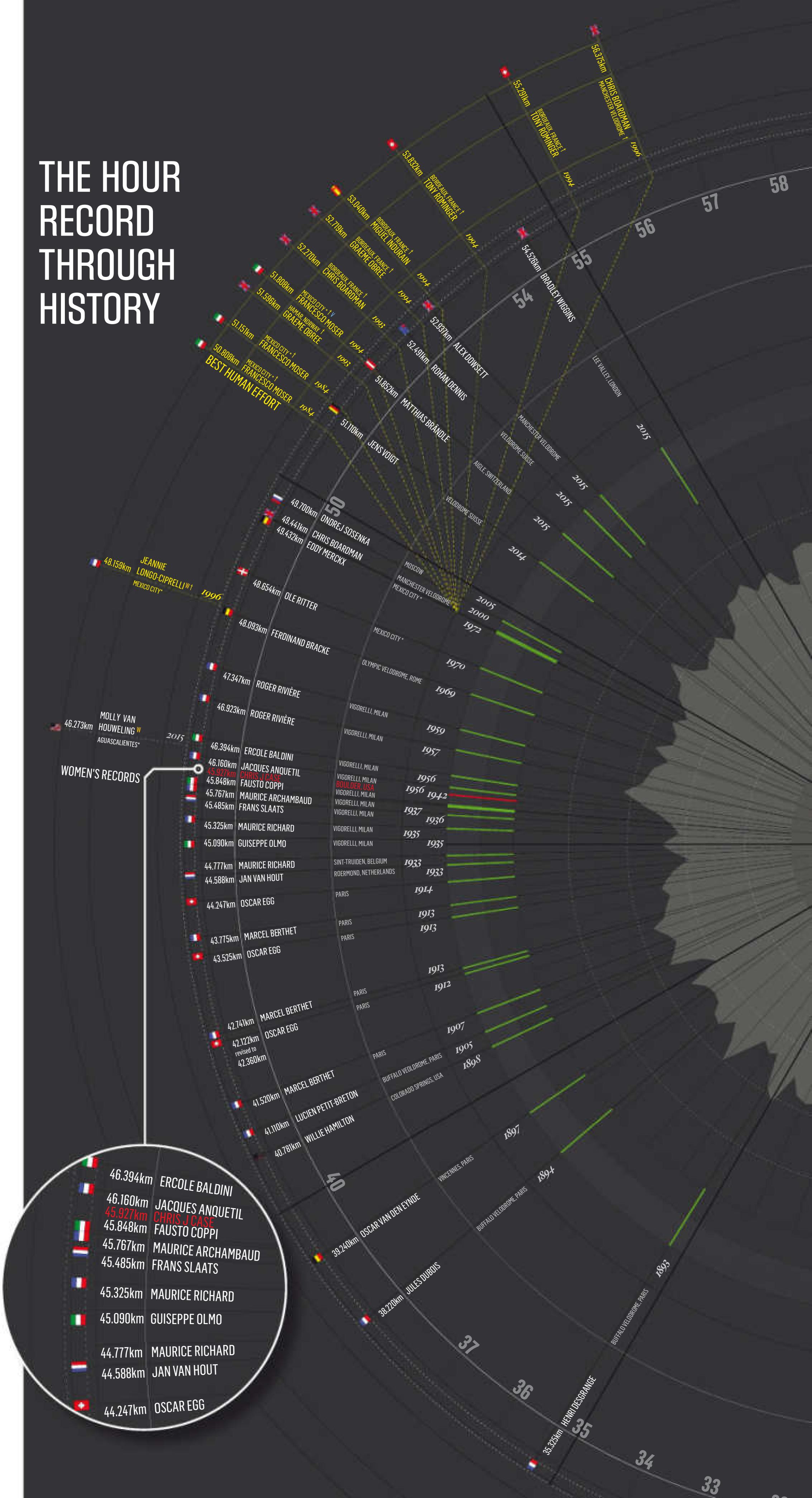
Since the rule changes in late 2014 that allowed for modern pursuit bikes to be used for the event, the quest to set a new, modern mark has seen a resurgence. Aerodynamics is now squarely back on the table; riders and teams have clearly defined constraints in which to work as they attempt to minimize every gram of drag.

"You can't take this stuff for granted," says aerodynamics specialist Andy Froncioni, who holds a Ph.D. from Rutgers in aerospace and mechanical engineering. "This is a good 105 years of engineering that's coming together. The airplane wing is not a shape that came easily. It's significant technology. And you look at a modern bike and it's easily taken for granted now, but it's not nothing."

Froncioni works his magic for Montreal-based Alphamantis, a firm that specializes in making cyclists faster. They have pioneered a system that enables them to determine in real-time the optimal position and equipment combination for rider and bike. No wind tunnel necessary.

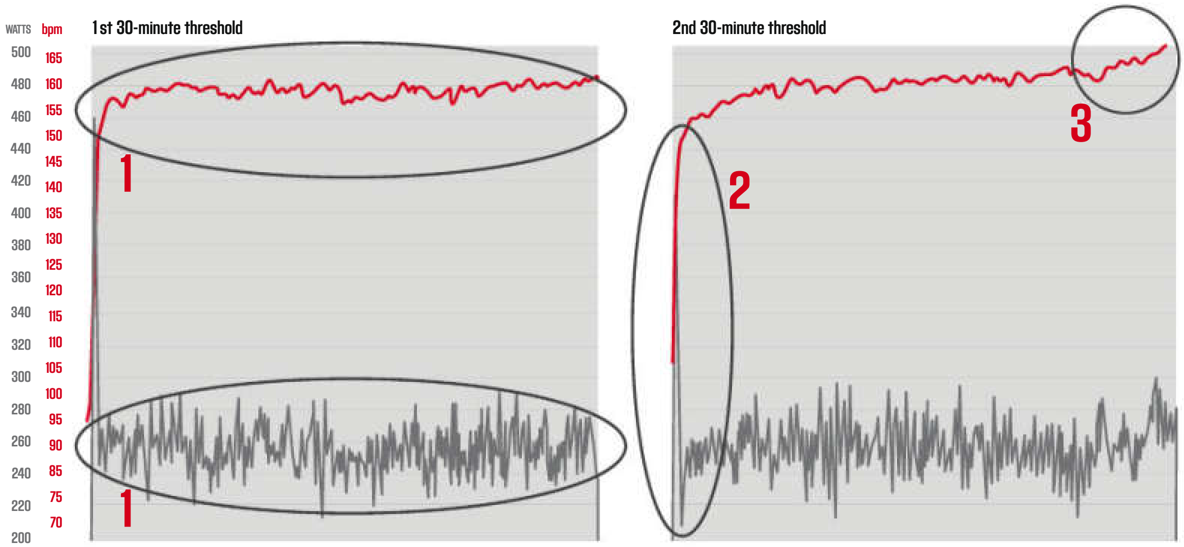
The findings from their research are never to

# THE HOUR RECORD THROUGH HISTORY



# MORE THAN A NUMBER

BY TREVOR CONNOR, CHRIS'S COACH FOR HIS HOUR ATTEMPT



### TRAINING SESSION #6

**1.** Steady power, cadence, and heart rate are a hallmark of great pacing. A constant rise in his heart rate relative to power would have indicated he was going too hard.

**2.** We see the biggest wattage at the start to get up to speed. Had he gone too hard, Chris would have built up lactic acid that would have hurt him later on.

**3.** A small effort right at the end showed that Chris didn't overdo it.

**THE PARETO PRINCIPLE,** more commonly known as the 80–20 rule, is a business principle that holds that roughly 80 percent of effects come from 20 percent of causes. That is, a minority of inputs has a disproportional impact on the end result. This definitely holds true for the hour record. In such a controlled, predictable event, little things make a big difference.

This can be dangerous, because it can overstate just how much control one has over the many factors involved in such a demanding performance. Focusing on frontal areas and coefficients of drag can turn the rider into a formula, when the truth is the rider is a human who might not be feeling well. Yet Chris and I read studies that did exactly that. One in particular wrestled with why Indurain's attempt didn't live up to his formulaically predicted performance. It didn't consider he might have just had a bad day.

Chris and I got caught up in numbers, too, and almost forgot what was important: If he trained optimally and showed up mentally and physically prepared, he'd produce his best result. Here are the steps we took to ensure Chris was ready.

## FINDING THE THRESHOLD

This type of training can't be done by feel. Chris doesn't typically train with a power meter, so we performed multiple tests to determine his functional threshold in his hour position. A 20-minute all-out effort on the track provided a 260-watt estimate. (That was down from 320 watts on the road; this drop indicated that adaptation to the position would be an issue.) Ultimately, his threshold was determined in the lab by Rob Pickels, the lead physiologist at the University of Colorado Medicine and Performance Center. Chris's highest sustainable power was measured at 275 watts.

ILLUSTRATION COURTESY MASSIF CENTRAL (THEMASSIFCENTRAL.CO.UK)

## QUALITY OVER QUANTITY

Last year Chris prepared for a four-hour hill climb by flogging himself on mountain passes and then riding two additional hours. That type of training doesn't work for the hour attempt.

Now, his training consisted of two short threshold sessions per week that he performed fully rested. Everything else was easy rides of an hour or two, two or three times per week.

In total, given the short schedule he had to prepare for his attempt, he performed just seven structured workouts on the track, all done at 90 percent of functional threshold power (except the final session):

❶ 4 x 8-minutes
*(3 minutes rest in between)*
❷ 4 x 10" (3")
❸ 4 x 12" (3")
❹ 3 x 15" (5")
❺ 2 x 20" + 10" (5")
❻ 30" + 30" (5")
❼ 30" at race pace

## GIVE IT 90 PERCENT

Chris performed intervals at 260 watts, rather than at his aerobic limit of 275 watts, since training right on that edge can cause too much stress and actually target the wrong energy systems.

"Threshold power is that workload where everything is barely holding on and still functioning fairly well," Pickels says. "You go a little above that, and things go haywire. You go below it, you're pushing the limit, but you're in a controlled environment. When we look at lactate clearance, just below that threshold is where the body is recycling lactate and other metabolites the fastest. So the body does really well when we train in a place where it's successful."

## STAMINA & CONSISTENCY

Theoretically, Chris would be able to hold his threshold power of 275 watts for the hour. In practice, doing that while staying steady in an aerodynamic position can be mentally and physically excruciating.

To refine these qualities, Chris focused on holding his position at a steady wattage every workout. Initially, he did only five-minute intervals. These grew in length until he was sustaining two 30-minute intervals to accumulate an hour at threshold (see graphic). Unfortunately, the head unit to Chris's power meter was inadvertently powered down just before the attempt, so no data is available from his hour.

## FAMILIARITY

At first, Chris couldn't get close to his threshold heart rate. I attributed this to his unfamiliarity with the bike and the high-cadence demands of the track. In fact, Chris had never raced on the track before, and had only done one time trial in the aero position in his life (on a 1990s vintage KHS with clip-on bars, no less). While it was critical for Chris's position that he balance power and aerodynamics, his body still had to adapt to this new style of riding. So he performed his intervals on his track bike, and two weeks from the event we stopped making changes. As he became more familiar with the position, both his power and frontal area improved.

be applied universally—there are always exceptions to the rules—but they have seen trends that can't be ignored. To emphasize just how much aerodynamics can mean to a record attempt, it's best to understand air density, which varies with barometric pressure and temperature, both of which are influenced by altitude. Hotter air is faster. Moister air is faster.

Air density determines the mass of air that you displace as you ride through it. For example, a cubic meter of air at the velodrome in Aguascalientes, Mexico, which sits at almost 6,200 feet, is about 0.96 kilograms. At sea level, it's 1.2 kilograms. That's a difference of almost 0.25 kilograms for every cubic meter of air that you're displacing. "Over 60 minutes, that adds up to a big difference," Froncioni says. "That's an important, invisible part of the hour record."

At race speed, particularly on a track, nearly 90 percent of your aerodynamic drag comes from your body. Reducing the amount of air you're pushing reduces the amount of energy you expend to move forward. Therefore, under the same power, you can go faster.

Imagine a bullet shot through the air at an angle—it wouldn't fly very smoothly, or quickly. That's because air would go over the tip then leave the surface of the bullet and begin recirculating, creating a vortex above and behind it. That vortex has a negative pressure and will actually pull backwards on the bullet.

"Same with the human being," Froncioni says. "You want to have flow that goes over the back and detaches as late as possible. You want that bubble of negative pressure to be as small as possible." Cyclists ride along with an eddy behind them that's tugging them backwards. Aerodynamic positioning has everything to do with reducing the size and strength of those eddies.

Through repeated inquiry on the track, Alphamantis has also discovered the significance of the up-tilted forearm position. Look at Wiggins in his hour and it harkens back to the days of Floyd Landis and his "praying mantis" position. That up-tilted forearm went away only because the UCI mandated it. Since removed from the rulebooks, new rules stipulate that the top of the extension can not be more than 10 centimeters higher than the lowest point of the top of the arm pad. But the horizontal position lives on.

"We're still living the history of that rule, where people still like the look of that flat arm position," Froncioni says. "A lot of position coaches without any aerodynamic knowledge will put people in that position. It certainly looks faster, but there's no way that it is. Just about every time we test forearm tilt, it is definitely better than flat arm."

The air, power meter, and *CdA* figures don't tell aerodynamicists why that position is faster. But Froncioni surmises that by lifting the fists up, there's a core of air that remains untouched as it goes over a number of aerodynamic elements on the bicycle that produce such little drag they are said to be invisible.

That little core of air? "Just subtract it right out of the picture," Froncioni says.

A frame accounts for 10 percent of your drag. Frames with a low stack figure (the dimension from center of bottom bracket to top of head tube) offer the opportunity to separate rider from bike, in a sense, by allowing for the use of high risers under the arm pads.

"Having your arm pads and extensions right on the base bar introduces complex shapes into that space creating a lot of dirty air," he says.

In the end, the key to speed isn't just formulas and physics but a balanced position that considers aerodynamics, the cleanliness of the design and configuration, and power output. It takes time and patience to find that balance.

> "BEING A WORLD-CLASS TIME TRIALIST IS AN ACT OF CONTORTIONISM. PEOPLE LIKE THAT WHO HAPPEN TO HAVE GOOD $VO_2$S AND SMOOTH PEDAL STROKES AND AERO-SHAPED ASSES ARE REALLY GOOD TIME TRIALISTS."
>
> — COLBY PEARCE

A hierarchy of choice simplifies things: 1) The best position is the fastest; 2) the fastest position works within your individual biomechanical profile; 3) the fastest position must be sustainable; 4) if sustainability and aerodynamics come into conflict, choose sustainability.

Sometimes, it all comes together.

"Being a world-class time trialist is an act of contortionism," Pearce says. "It's not just about having a big VO2. It's about shrugging the shoulders up to the ears, making the whole frontal area around your clavicle all the way up through the neck disappear and making the upper arm segments vertical as opposed to sticking out like struts. The people who can do that and happen to have good VO2s and smooth pedal strokes and aero-shaped asses are really good time trialists."

It cost $9,500 to create Bradley Wiggins's chain for his hour-record attempt, according to Muc-Off, the company that provided it. The British firm used a machine to quantify the efficiency and durability of its chain lubricant formulations. It then tested more than 30 Shimano Dura-Ace chains to select the most efficient ones, deep cleaned those in a sonic bath, then applied a specially formulated lubricant to reduce friction.

What reports didn't share was that Jason Smith, the man behind FrictionFacts.com, gave Muc-Off the plans for both the machine and his optimized lubricant treatment. Working from his basement laboratory in Boulder, Colorado, Smith has pioneered the research of drivetrain efficiency, finding small (sometimes very small) ways in which to decrease the power loss due to friction. You've heard of marginal gains? He lives them.

Smith, who holds a degree from Penn State in ceramic science engineering, estimates that the Muc-Off chain helped Wiggins ride an extra 250 meters over the hour. Having designed and built machines that test chain efficiency to 1/50th of a watt, Smith has devoted his life to cheap speed.

How much speed can you find by obtaining the right chain and being smart about how you prepare it? Two percent. In fact, when Smith still prepared the chains (he sold that technology to Ceramicspeed in May 2015), he guaranteed it.

When it comes to finding the right chain, Smith has done the work for you. "From all of the testing we have done, the Dura-Ace is consistently the fastest model," he says.

It goes without saying that your chainring and rear cog need to be aligned, since misalignment creates friction. The art of tensioning the chain also takes practice. It should be slacked—tension causes friction—but you don't want the chain flopping around. It's a fine balance.

"All our tests are done at 250 watts," Smith says. "You get a guy like Bradley Wiggins, who did his at over 400 watts, and everything is linear, so it would be even more. So, straight out of the box, at 250 watts, between 10 and 7 watts is what you save with that type of treatment. It's at least 5 watts of savings. At 250 watts that's about two percent. That's a fair amount off the top, and that's just with the chain."

In your search for ultimate speed, you must also consider the bearing design, the seals, and the lubricant. Ceramics help. They're not necessarily faster than steel, but the quality of the product is higher to begin with, so the tolerances are tighter. Though he wouldn't necessarily suggest it for long-term durability, Smith has shown that removing seals, cleaning, and then applying two to three drops of a delicate oil—he suggests a remote-control car bearing oil—provides the most efficient set of bottom bracket bearings possible.

These increasingly small gains carry over to rolling resistance, found at the interface of tire and track (see page 54). Wheel Energy, of Finland, specializes in tire efficiency research and testing. They found that at a speed of 50 kph, the best and worst tubular track tires can mean a difference of between seven and 10 watts. Furthermore, to be specific to differences within a tire, the Vittoria Pista CS Elite tire was eight watts more efficient

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**SHATTERED**
Utterly depleted, Case is held upright by Legan at the conclusion of the hour.

at 203 psi than at 102 psi. Of course, results will differ between brands and casings. But in the world of infinitesimal gains, it's just this type of research, yielding just these types of advantages, that leads to world records—or not.

*Arc into the corner and float around the bend. Eyes on the line, power down the straight, carve toward the apex of the curve. Damn, not perfect. Try again. Find the line and ride it. Throttle on the straights, lift in the corner. Damn, not perfect. Try again. Hit the black line. Keep low, keep steady, keep smooth. Damn, not perfect. Try again.*

There are nuances to riding on a velodrome that can't be ignored. Distance is measured in laps, regardless of how high on the track you ride. The higher you are, the larger diameter circle you're covering on every lap—and you'll gain a small amount of altitude by climbing the banking, which counters the natural acceleration you would normally get in the corners. But you'll get no extra credit. An ideal ride stays as close to the black line as possible, which is where the track's distance is measured. But there is a fine line between pressing too hard to be on that line and staying relaxed so as not to waste energy. If you were to ride, on average, 20 centimeters from the black line over the course of an hour, you would ride an extra 250 meters for which you would not get credit. On most tracks, that's an extra lap. According to Pearce's rough estimate, Jens Voigt, an inexperienced track cyclist, could have lost as much as 400 meters in total distance by frequently drifting above the line during his record-breaking hour attempt in 2014.

But watch Dowsett or Wiggins. Placid, still, yet powerful, comfortable, and incredibly smooth.

"You look at Dowsett and that guy was just pinned on the black line," Pearce says. "And the same with Wiggins. Metronomes. And that's what it is: rhythm. That's what cycling is. You build the pressure, and on the good days you can find the rhythm with the throttle all the way open. On the track, the positive is you're doing laps. There's a really clear indicator of what your rhythm should be. You get to try it again the next lap. In fact, you'll have almost 200 opportunities to get it right [laughs]."

On the track, power goes up on the straights. In the corners, your center of gravity shifts and you accelerate—you have to accelerate. So your wheels accelerate. But they're also doing a bigger circle, so they accelerate more relative to you. That repeated fluctuation in cadence and power output is what makes riding long-distance efforts on the track even more dynamic.

"It's not the same as Cancellara out there for a 40km TT on the road," Pearce says. "The hour is a different beast, and the power profiles are different, too. It's surge and recover, surge and recover. I think that's why some people get on the track and their heads just explode."

Look at any modern time trialist on the road and he is scrunching his body into a tiny ball, tucking his head at every opportunity. Not so when you're doing lap after lap on a velodrome. There, you're under a repetitive centripetal-force burden, which loads your inner ear and challenges your balance system. And, remember, you're having to process all of this at threshold, going 30 miles per hour.

Thus, stillness is essential.

"You go through these corners and your inner ear, your balance challenge, gets to be higher and higher," Pearce says. "If you were to try to drop your head to be super aero on the straights and then raise your head in the corners to see where you were going and try to match the black line, I don't think it would work at all. It would only add to that challenge."

Instead, you want consistent rhythm. If you want to go forward, you look where you want to go. Study Wiggins. Watch Dowsett. Metronomes. Fast metronomes, ticking away.

I crept delicately around the track, completely dazed, finally coming to a stop near the gathered fans. Legan held me upright, helped me unclip my right foot from the pedal, and I slowly, deliberately swung my leg over my saddle onto the concrete apron. I stood there, head down, aching in a near-catatonic state of relief and emptiness.

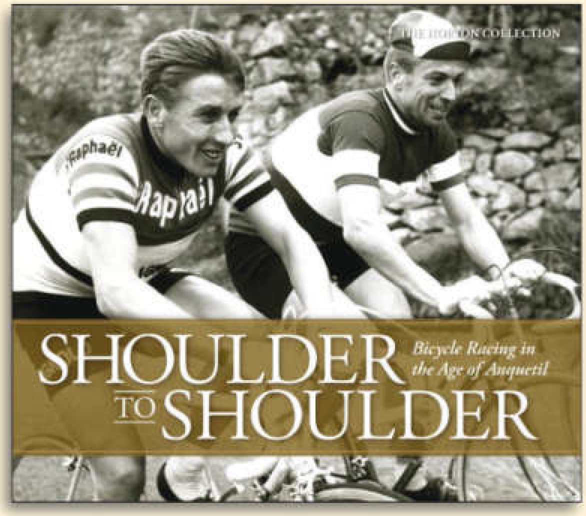
"How far?" I asked.

"Far. I might have been lying to you a bit on your lap times," Nick said. "Over the record."

My distance of 45.927 kilometers was deemed a new track record, but since USA Cycling officials were not present to oversee the attempt (none could be arranged on the weekend of the road world championships in Richmond), my unofficial distance, though farther than the existing 35–39 national record, will not be recognized.

Later, I'm told I rode farther than Fausto Coppi and came up just short of besting Jacques Anquetil. Nothing could have more quickly made me realize what I had just done or made my ravaged body ache a little less. Anything for a good story.

# AGE OF ANQUETIL



With a comb in his pocket and his glamorous blonde wife by his side, Jacques Anquetil was the first true superstar of cycling and the founder of the modern, cosmopolitan sport it has become. *Shoulder to Shoulder* ushers us into the zenith of Anquetil's career, the 1960s, with a fully restored collection of rare and valuable photographs.

Presenting more than 100 brilliant images of Anquetil, Rik van Looy, Tom Simpson, Raymond Poulidor, Jan Janssen, Miguel Poblet, Rudi Altig, Federico Bahamontes, and many more, *Shoulder to Shoulder* showcases the rise of a generation—and of cycling's modern era.

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# Mind over muscle

## New science suggests that signals of fatigue may reside in the brain

BY IAN MCMAHAN

**AUSTRALIAN CYCLIST** Jack Bobridge is well acquainted with the physical pain of pushing his body to the limit. But even a career on the track and road didn't prepare him for the pain of what was to be an unsuccessful attempt on the hour record earlier this year. (His pacing didn't help.)

"This is the closest to death I will ever be, I think, before actually dying," Bobridge told the assembled media. "I can't even describe how much pain my glutes and quads are in. It's unbelievable."

But was his suffering—like his determination to continue pushing the pedals—limited more by his head than his legs? For all the talk of burning quads and glutes, some scientists now believe that fatigue may be more complicated a process than originally thought, one that is as much psychological as it is physiological.

"According to this model," writes Timothy Noakes, a professor of exercise and sports science at the University of Cape Town, "the winning athlete is the one whose illusionary symptoms [of fatigue] interfere the least with the actual performance—in much the same way that the most successful golfer is the one who does not consciously think when playing any shot."

That's the idea behind the central-governor theory, a model Noakes first proposed in 2001 that suggests the brain has a safety switch that kicks in to prevent the body from getting too close to dangerous limits. And it does this before it needs to—the brain's way of protecting us from ourselves.

The point at which the brain feels like enough is enough has to do with fitness, fuel, and natural ability. But regardless of when you start to feel it, the central-governor theory holds that it's not so much that your legs have had enough as it is that your brain is telling your legs they've had enough.

So Jens Voigt had it wrong. The better tagline

ISTOCKPHOTO

**BRAINS GAMES**
Could Jack Bobridge have gone farther during his hour record attempt, despite the physical pain he was in? Were Jens Voigt's legs what was holding him back? New science suggests the real problem was all in their heads.

would be "shut up, brain."

Noakes wasn't the first to question the view that an individual's physical performance has absolute, physiological limits. In the early 20th century, Italian researcher Angelo Mosso proposed the theory that physical limits may be controlled less by our body and more by our brain. While perhaps ahead of his time, Mosso's concept of central fatigue soon gave way to Nobel laureate A.V. Hill's idea that peripheral fatigue—that is, all the physiological stuff having to do with muscles and lactate and fuel and everything else we know—was the sole determinant of exercise fatigue.

Current research, led by Noakes and Samuele Marcora of the University of Kent's Endurance Research Group, has revitalized the suggestion that the brain, acting in self-preservation mode, cuts off signals to working muscles when it senses that effort is too high.

The difficult part for scientists is that a central control switch can't be measured or localized like other signs of exertion. We can test for blood lactate or oxygen consumption, but the central regulator has yet to be found.

But importantly for cyclists looking to adjust the central governor, training doesn't just build bigger muscles and a better aerobic capacity; hard workouts also teach the brain that high levels of exertion aren't life threatening. The heart didn't explode after that hard interval, and muscles and tendons are still intact; ride on.

"The brain learns to tolerate heat, lack of oxygen, muscle pain—basically it becomes better at suffering," says Allen Lim, a sports physiologist and founder of Skratch Labs.

Much evidence for a central regulation of fatigue is indirect, since it's understood that peripheral mechanisms can't explain everything we know about fatigue. One supporting factor comes from studies using mostly trained, male subjects, showing that cyclists can trick their bodies into riding faster simply by rinsing their mouths with a carbohydrate solution then spitting it out. Though they didn't ingest the carbs and therefore none of the physiological benefits, on average riders in these studies improved power output by two to 11 percent. This suggests that simply letting the brain think there's extra fuel could be enough to delay the kill switch.

The central governor also plays a protective role in hot conditions, reducing performance to limit a rise in core temperature. In a 2012 study conducted in England, researchers had competitive cyclists run two trials in temperatures of 72 and 90 degrees Fahrenheit. Core temperature for both rides was the same, yet the distance the cyclists achieved was four percent lower, and average power output was reduced on the hot rides. Interestingly, in a third trial, when the researchers deceived the cyclists into believing that the temperature was 79 degrees instead of the actual 90 degrees, the difference in performance disappeared. The researchers concluded that when the brain senses higher ambient temperatures, it reduces output to protect the body from heat injury.

But Lim emphasizes that, just as training teaches our brain to suffer, heat acclimatization can change the set point at which the brain raises the white flag. In a 2015 study, uninitiated riders saw a 16 percent drop in power between hot (97 degree Fahrenheit) and cool conditions (47 degrees Fahrenheit). After 14 days of heat acclimatization, the power difference lessened to only three percent between the two temperature scenarios.

Researchers have also shown that mental fatigue—the type induced by a long, difficult exam for instance—impairs subsequent endurance performance. In a 2009 study at Bangor University in Wales, cyclists were divided into two groups and asked to pedal at 80 percent of peak power for as long as they could. The only difference between the two groups was that one group had to undergo 90 minutes of cognitive testing requiring sustained attention and a memory challenge. The other group watched a documentary on trains. The mentally exhausted riders dropped out an average of 15 percent earlier.

So the day before a big race is not the time to close on a new house, buy a car, or do your taxes.

When it comes to cyclists, cadence may be another way to trick the brain into giving the body a longer leash. Training at both high and low cadences delivers similar improvements in physiological exercise capacity, but high-cadence training seems to increase measures of brain efficiency, according to a 2015 study conducted at the University of Basel in Switzerland. As compared to the low cadence group (90 rpm), cyclists that had trained using high cadence (120 rpm) were able to exercise using reduced EEG measured brain activation (a good thing) despite identical intensity.

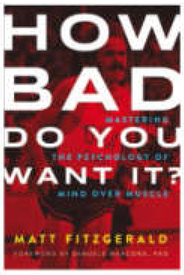
In the end, training lets us go farther faster. That hasn't changed. What is evolving, though, is our understanding of how that training helps us. Endurance sports are artificially induced struggles, and it's during the struggle that systems adapt—not only heart and lungs but also the brain.

"Training the brain allows it to understand what's possible," Lim says. And with a little bit of trickery, you might convince your brain that you're capable of even more.

THEO KARANIKOS/GETTY IMAGES; AARON ONTIVEROZ/GETTY IMAGES

# TIME IS ON YOUR SIDE

Greg LeMond's 1989 Tour de France win shows how a simple mental trick can make you go faster.



Republished with permission of VeloPress from *How Bad Do You Want it? Mastering the Psychology of Mind over Muscle*, by Matt Fitzgerald. Read more at velopress.com

**GREG LEMOND WOKE UP** in a strange bed. For a second or two he knew nothing more, his mind hovering in that narrative-free state of animal consciousness that greets each of us at the threshold of wakefulness. Then it all came back to him. He was in a hotel room in Versailles, France. The date was Sunday, July 23, 1989. At 4:14 that afternoon, he would compete in the final stage of the Tour de France. It was going to be the most important race of his life.

There was plenty of time left to kill. As the second-place rider in the general classification, LeMond would start the conclusive 24.5-km individual time trial next to last among the Tour's 134 surviving competitors, two minutes before Frenchman Laurent Fignon, the race leader.

A two-time winner of the Tour de France, Fignon stood merely 50 seconds ahead of LeMond after 20 stages and more than 2,000 miles of riding. LeMond was the stronger time trialist, but he would have to make up an improbable two seconds per kilometer between Versailles and Paris to overtake Fignon and claim his own second Tour de France victory. Whichever way it went, it promised to be the closest finish in the event's 76-year history.

The mountains that year had taught LeMond that, despite his high hopes, he was not quite as strong as he'd been when he won the Tour in 1986, nor—as he would confess after his retirement—would he ever be. He was riding with 30 shotgun pellets in his body, after all. What's more, he was up against two past Tour winners—Laurent Fignon and Pedro Delgado—who'd been caught doping and perhaps were cheating still. If LeMond were to beat them, his mind would have to find a way to do more with less—to become stronger to the same degree that his body was weaker.

He told reporters that he believed the task facing him lay at the very outer limits of the achievable. He was not certain that he could pull it off even if he gave more than he had ever given before on a day when he had more to give than ever before. Nor was he certain that he couldn't. It is hard to imagine a goal construct that would have elicited a better performance from LeMond in the most important race of his life.

> The goal of improving your time for a certain distance by one second almost always seems attainable. And if that goal is attainable, then the very slightly greater level of perceived effort that an athlete must endure to achieve it is likely to seem more endurable.

A time trial is an exercise in pacing, as are all races that last longer than 30 seconds. In races shorter than 30 seconds, competitors go all-out, pedaling, striding, or stroking at absolute maximum intensity from start to finish. They hold nothing back and utilize their full physical capacity. In races that last longer than 30 seconds, competitors do hold back at all points of the race except perhaps the very end. Instead of going all-out, they maintain the highest intensity they feel capable of sustaining through the full race distance.

Why 30 seconds? Because humans cannot sustain maximum-intensity exercise longer than about that length of time without exceeding the highest level of perceived effort they can tolerate. Athletes are conscious of their effort in shorter races, of course, but because they know their suffering will end quickly, they do not use this perception to control their pace, which is constrained only by their physical capacity. But when athletes start a race that they know will last longer than 30 seconds, they hold back just enough that they don't reach the perceived-effort limit until the finish line. That is the art of pacing.

What happens when an athlete tries to sustain a maximum intensity of exercise longer than 30 seconds? Anna Wittekind of the University of Essex answered this question in a 2009 study published in the British Journal of Sports Medicine. Nine subjects were asked to ride stationary bikes outfitted with power meters as hard as they could for five seconds, 15 seconds, 30 seconds, and 45 seconds on separate occasions. When she reviewed the results, Wittekind found that the subjects had generated slightly less power during the first 15 seconds of the 45-second test than they had in the 15-second test. In other words, they had not pedaled as hard as they could at the start of the longest test ride, even though they had been instructed to do so. Instead, they had unconsciously paced themselves.

Wittekind speculated that, on the basis of past experience, the subjects recognized that they could not sustain a true maximal effort for 45 seconds without exceeding their maximum tolerance for perceived effort, so they held back just a little, without even realizing it.

These results suggest that the limit of maximum perceived effort tolerance is so impenetrable that athletes are not psychologically capable of even trying to sustain a maximum exercise intensity longer than approximately 30 seconds.

The fact that pacing is required to maximize performance in all races lasting longer than half a minute has some interesting implications. A sprinter finishes every race knowing he went as fast as he could (technical errors notwithstanding). Longer races are different. Because it is necessary to hold back to some degree at almost every point in these races, it is impossible for the athlete to know upon finishing whether he might have gone faster—if only by a second or two—if he'd held back just a bit less somewhere along the way.

Many automobiles have a range feature that displays the number of miles the vehicle can travel before it runs out of gasoline. This number is not open to interpretation. If the range display says 29 miles, you'd better find a gas station within the next 29 miles. The mechanism

ISTOCKPHOTO

**EIGHT SECONDS**
Greg LeMond overcame a seemingly insurmountable deficit to shock the world and take the yellow jersey on the last day of the 1989 Tour de France.

GETTY IMAGES

> Regardless of how an athlete chooses to train, her training will yield greater improvements in race times if improving race times is the explicit goal of the training process.

of regulatory anticipation that athletes use to control their pace in races is different. It's not a number but a feeling, and like all feelings it is open to interpretation.

One of the most important and valuable coping skills in endurance sports is the ability to interpret the perceptions that influence pacing decisions in a performance-maximizing way. As an endurance athlete, you want to get better and better at reading these perceptions in such a way that your internal pacing mechanism functions more and more like an automobile's range display. You want to be as correct as you can possibly be when determining the swiftest pace you can sustain to the finish line without exceeding your perceived effort tolerance.

Validation of this approach comes from a 1997 study done by researchers at Israel's Ben-Gurion University and published in the Journal of Sports Science. High school students were subjected to a test of muscular endurance and then spent eight weeks training to increase their time to exhaustion. Some of the students were given a non-quantitative goal to "do their best." Others were given a quantitative goal to better their performance in the initial test by a certain percentage. Even though all of the students did the same training, those who pursued quantitative goals improved their performance significantly more when the muscular endurance test was repeated after eight weeks.

More recently, a team of researchers led by Eric Allen of the University of California found that finish times in marathons tend to cluster near the round numbers (such as 4:30 and 4:00) that runners typically set as goals. This pattern would have carried little significance if Allen and his colleagues had not also noted that those runners who end up closest to these round numbers at the finish line slow down less than other runners in the final miles of a marathon—evidence that the pursuit of these round-number goals enhances performance. Regardless of how an athlete chooses to train, her training will yield greater improvement in race times if improving race times is the explicit goal of the training process.

Paying attention to the clock reduces the uncertainty associated with reaching beyond past limits and in this way facilitates effective pacing. While it may be impossible for an athlete who completes a race of a certain distance to know if he could have tried harder, it's relatively easy for an athlete who completes a race of a certain distance in a certain time to aim to cover the next race of the same distance a second or two faster than he did the last time.

According to Samuele Marcora's psychobiological model of endurance performance, the amount of effort that an athlete puts into a race is influenced by her perception of the attainability of her goal, a concept borrowed from Jack Brehm's theory of motivational intensity. If the goal seems to fall out of reach at any point during the race, the athlete is likely to back off. If the goal seems attainable, but only with increased effort, the athlete is likely to up the pace, provided she's not already at her limit.

By keeping track of—and aiming to improve—personal best times for specific race

BOB THOMAS/GETTY IMAGES

**PERSONAL BEST**
South African Elana Meyer used time-based goals to steadily recalibrate what she was capable of at the half-marathon distance, repeatedly setting world records along the way.

> Meyer's pursuit of time goals played a role in her development. Her last two world records were set on familiar courses where she set out deliberately to run faster than ever before.

distances, athletes can exploit this phenomenon to try harder than they would otherwise be able to. The goal of improving your time for a certain distance by one measly second almost always seems attainable. And if that goal is attainable, then the very slightly greater level of perceived effort that an athlete must endure to achieve it is likely to seem more endurable than it would seem if the athlete were going entirely by feel. It's not the time goal itself that enhances performance but the effect that the goal has on how the athlete interprets her perception of effort.

Setting time-based goals that stretch you just beyond past limits is like setting a flag next to a bed of hot coals to mark the furthest point reached in your best fire walk. That flag says to you, "This is possible, and you know it. So why wouldn't it be possible for you to make it just one step farther the next time?"

---

A real-world example of this process of using time-based goals to recalibrate perceived effort in a performance-enhancing way is South African runner Elana Meyer's career progression at the half-marathon distance. In 1980, when she was 13 years old, Meyer took her first shot at 13.1 miles, winning the Foot of Africa half-marathon in a mind-boggling time of 1:27:10. Nine years later, she made her professional debut at the same distance, running 1:09:26 in Durban. In 1991, she smashed the half-marathon world record in London, clocking 1:07:59. Between 1997 and 1999, Meyer broke the record thrice more, running 1:07:36, 1:07:29, and, finally, 1:06:44 in Tokyo at age 32.

Obviously, Meyer's development as an athlete was responsible for much of this improvement. But her pursuit of time goals also played a role. Her last two world records were set on familiar courses where she had already posted fast times, and in each of these cases she set out deliberately to run faster than ever before. It's likely that Meyer was not any fitter at the 1999 Tokyo Half Marathon, where she ran 1:06:44, than she had been a year earlier in Kyoto, where she ran 1:07:29, but she had the crucial advantage of having run 1:07:29 already.

But wait: If Meyer was just as fit (not to mention a year younger) when she ran the slower time, then can it not be said that timekeeping held her back in the 1998 Kyoto Half Marathon, even as it pulled her beyond the world record of 1:07:36 she had set on the same course in 1997? There is indeed evidence that the influence of clock watching on endurance performance is two-sided. The same time goal that enhances performance when it is perceived as a target constrains performance when it is perceived as a limit.

The potential for time standards to become performance limiters is most apparent at the elite level of endurance sports. There have been many noteworthy cases in which a performance breakthrough by one athlete triggered a widespread revolution in performance and thereby revealed that previous standards had been holding the sport back.

Between 1994 and 2008, for example, the

women's world record for triathlon's Ironman distance was stuck at 8:50:53. Only seven women recorded times under nine hours in that 14-year span. When Yvonne van Vlerken finally lowered the Ironman world record to 8:45:48 in July 2008, the floodgates were opened. Six other women dipped under the nine-hour barrier in the next few months. By the end of the 2011 season, the Ironman world record for women stood at 8:18:13, and sub-8:50 performances had become commonplace.

> His plan was simple: to ride just a bit faster than he ever had, holding back a little less than he had ever dared in similar circumstances.

2

SEC./KM

Was the new generation of female triathletes that much more talented than the previous one? No. These women just weren't held back by a tendency to regard the time of 8:50:53 as an unsurpassable human limit.

In consideration of the two-sided nature of time's effect on endurance performance, it is tempting to ask what sort of time goal would have the best possible effect on performance. Such a goal would need to seem reachable, but barely so. (Indeed, in the Ben-Gurion University study students given a "difficult/realistic" goal improved more than those given either an "easy" goal or an "improbable/unattainable" goal.) This ideal goal would also need to be sufficiently well defined to pull the athlete beyond past limits, yet somehow vague enough that it did not place an artificial ceiling on the athlete's performance.

Greg LeMond's situation at the start of stage 21 of the 1989 Tour de France met these requirements perfectly. He had to beat Laurent Fignon by 50 seconds. But Fignon would start behind him, so LeMond could not approach the race with a specific time in mind. Instead, LeMond knew only that he had to ride 50 seconds faster than the best time Fignon—one of the world's best time trialists besides LeMond himself—could conceivably achieve on his best day.

At 4:12 p.m., Pedro Delgado, who stood 1:38 behind LeMond in the G.C., rolled off the starting ramp and accelerated down the broad Avenue de Paris. It was now LeMond's turn to mount the platform.

"Cinq ... quatre ... troix ... deux ... un ... Allez!"

He stood on the pedals and began a hard windup. When he hit 100 revolutions per minute, he dropped onto the saddle and settled into the aero bars. His plan was simple: to ride just a bit faster than he ever had, holding back a little less than he had ever dared in similar circumstances. He lowered his head and rode with his eyes cast straight downward, as though indifferent to where he was going, looking up only briefly every few seconds to check his line.

He was already more than a mile down the road toward the Parisian suburb of Viroflay when Fignon set off behind him. With his granny glasses and blond ponytail, the Frenchman looked more like a high school drama teacher than a professional cyclist. Fignon had been seen fiddling around with a set of triathlon bars earlier in the day, but he'd elected to leave them behind. His bike did have the advantage of being outfitted with two aerodynamic disk wheels, however, whereas LeMond, expecting more crosswinds than he actually would encounter on the course, had gone with spokes in the front.

Fignon felt strong and confident. But after he passed five kilometers, his team manager, Cyrille Guimard, shouted from the trailing car, his words captured by a nearby cameraman's mic.

"Six secondes!" Guimard called out. "Vous avez perdu six secondes!"

That was how much time Fignon had already lost to LeMond. He turned his head and stared incredulously at Guimard. LeMond was not yet gaining the two seconds per kilometer he needed to overtake the Frenchman, but given how well Fignon himself was riding, he couldn't believe the American was going that much faster.

Up the road, LeMond received the same news from José de Cauwer. Before the race, LeMond had asked Cauwer not to supply any such information, and he tersely reminded his manager of that wish now. For the remainder of the time trial, his mind would be focused entirely on the only number that mattered: 50 seconds.

At 11.5 kilometers, LeMond passed an official time check. His split of 12:08 was the fastest of the day, by 20 seconds. Fignon reached the same point 2 minutes and 21 seconds later, having lost 21 seconds to LeMond since the start. As LeMond approached 14 kilometers, the deficit had risen to 24 seconds. LeMond still was not gaining time quite fast enough, but he felt strong, whereas Fignon's shoulders had begun to rock, a telltale sign of encroaching weariness.

The last part of the course skirted the famous Jardin des Tuileries and dumped riders onto the Champs-Élysées for the home stretch. When LeMond passed under a banner marking four kilometers to the finish, his advantage had stretched out to 35 seconds. He had stolen exactly two seconds per kilometer from Fignon over the last 6.5 kilometers; he would have to nearly double that rate of separation on the Champs-Élysées to win the Tour.

His last best chance to do that lay at three kilometers to go, where a false flat rose gently from the Place de la Concorde to the Arc de Triomphe. It wasn't much of a hill by Tour standards, but to an exhausted rider—as Fignon was quickly becoming—it would feel like a Pyrenean switchback. LeMond attacked it hard, telling himself that his career depended on it.

At the Arc de Triomphe, he made a hairpin right turn and entered the final straight. He finished at 26:57, beating the previous best time of the day by 33 seconds. When Fignon came into sight, he was visibly shattered with fatigue, no longer able to hold a straight line and nearly drifting into a barrier in his flailing efforts to drive his machine toward the line, which he crossed at 27:55. Greg LeMond had won the tour by just eight seconds.

His average speed for the 24.5-km time trial was 54.54 kilometers per hour (33.89 mph)—an all-time record for Tour de France time trials, by a long shot.

In the coming years, bikes would be completely transformed with stiffer, lighter materials; computer- and wind tunnel–assisted aerodynamics; and more efficient and reliable components and accessories. The sport was also entering an era of rampant and sophisticated doping. Most of the top riders of the 1990s and 2000s would gain a tremendous performance advantage from drugs such as erythropoietin (EPO). Yet none of these pharmaceutically enhanced athletes on space-age bikes was able to better LeMond's time trial speed record until 2005. And to this day, no Tour rider has ridden faster than LeMond except in shorter time trials undertaken on fresh legs on the first day of the race, instead of the last.

It would seem that, in the right circumstances, an old-fashioned stopwatch—properly used—can affect endurance performance more powerfully than either the finest equipment or the most potent chemicals—not to mention lift an athlete to his finest hour even after his best days are behind him.

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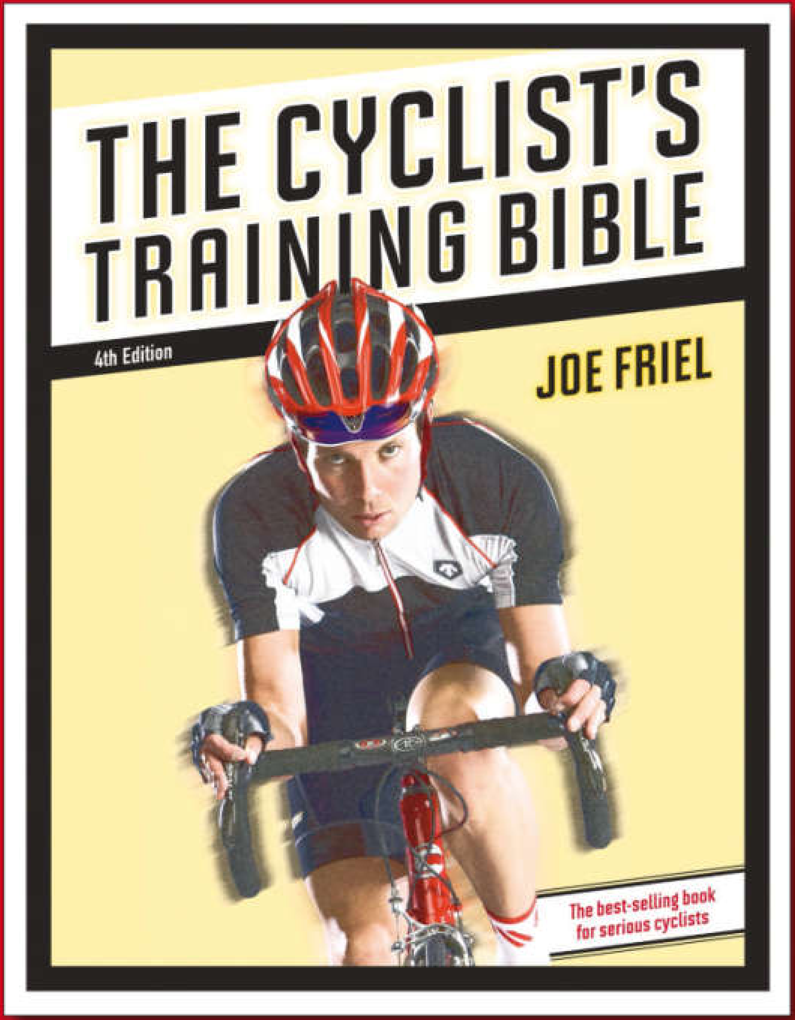
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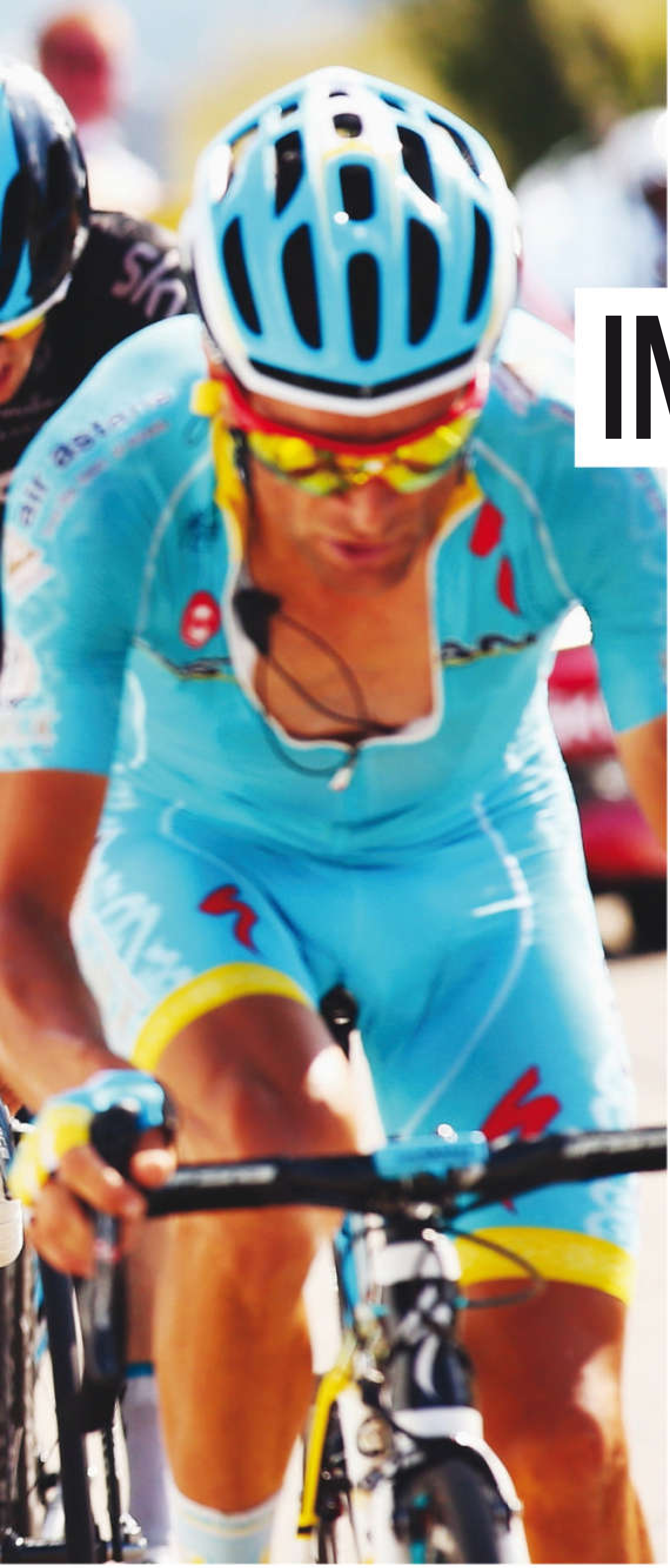

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# CYCLING'S IMPOSSIBLE SUMMIT?

## The grand tour double proved too challenging for everyone who tried in 2015

**BY ANDREW HOOD | SOTRES, SPAIN**

**IT WAS THE YEAR OF THE DOUBLE.** Or at least the double attempt. The 2015 racing calendar saw one of cycling's most cherished and difficult targets back in fashion.

Every major GC contender raced two grand tours in 2015, something not seen in 20 years, and all of them raced with every intention of winning.

From Alberto Contador (Tinkoff-Saxo) taking on the Giro d'Italia-Tour de France in May and July, to Chris Froome (Sky) trying to become the first rider to win the Vuelta a España after the Tour, the double was unexpectedly, and thrillingly, back in the conversation.

"I believe the double is possible," says Nairo Quintana (Movistar), who was second at the Tour and fourth at the Vuelta. "The Tour-Vuelta combo is more plausible. We saw Contador struggle after winning the Tour. I would like to try the 'doblete' in the future."

Why the recent resurgence? Ambition, sponsor pressure, and a new generation of riders looking to push the envelope of what's possible.

Merckx, Anquetil, Hinault—those are the mythical names in the peloton, and that's the company that Contador wants to be associated with. This summer, the most successful stage racer of his generation took aim at the history books.

"If I win one more Giro or one more Tour, it won't mean that much to my palmares," Contador said. "But if I could win the Giro and Tour in the same season, that would be truly something special."

At 32, Contador became the first rider to seriously take on the Giro-Tour double in more than a decade, and he almost got it right. Physically, he rode into the Giro a touch below peak fitness. Psychologically, he tried to think of the Giro and Tour as one race.

IT TAKES TWO
With his second place at the Giro and overall victory at the Vuelta, Fabio Aru came the closest to doing the double in 2015.

The Giro turned out to be a rougher ride than the Spaniard would have liked. He dislocated his shoulder in a high-speed crash in stage 6, and Fabio Aru and his Astana team pushed Contador to the maximum. Contador clearly suffered in the final week, even cracking on the final mountain stage over the gravel-strewn Finestre climb, but still managed to win.

Despite starting the Tour with optimism, Contador got shelled in the first mountain stage to La Pierre-Saint-Martin, losing 2:51 to Froome. Though he valiantly fought to the end to finish fifth, he was never truly a threat to the Team Sky leader.

"I think now his fifth at the Tour is standing up pretty good," says Tinkoff-Saxo sport director Tristan Hoffman. "The double is not impossible. Alberto was the only one to dare to try the Giro-Tour double in a long time. He said he didn't want to end his career without trying it, because it's one of cycling's big achievements."

Others aren't convinced. After watching Contador struggle in the Tour, many seem to believe that the Giro-Tour is simply too hard. In fact, Giuseppe Martinelli, the veteran Italian sport director who guided Pantani to his historic double in 1998, says he believes the Giro-Tour double is cycling's impossible summit.

"If Contador couldn't do it—a rider I know well and admire—it's difficult for anyone," Martinelli says. "I have always been convinced it's not only difficult but maybe even impossible these days. The Giro and Tour together is very difficult. There are not many riders who can realistically ride to win two grand tours in one season."

After the Tour, Contador pulled the plug on his season and vowed to focus exclusively on the Tour in 2016. He will not defend his Giro title. There will be no more attempts at the double for him.

"I wanted to try the double once before I retired," Contador says. "It's only impossible until someone does it. Maybe someone can achieve the double someday. One double attempt is enough for me. Next year, I will try to win the Tour one last time."

Winning one grand tour is hard enough, while two in a row is exponentially more difficult.

Many factors must line up: tremendous strength, teamwork, savvy, ruthlessness, and luck. Riders will negotiate 3,000 kilometers of terrain; endure 21 days of racing; avoid crashes, illness, weather, bonks, and all the other hurdles of the road; and beat everyone else. And then they must do it again less than a month later.

By any measure, that's a big ask.

# IRON MAN

## Adam Hansen's 13 consecutive grand tours set the new standard

Number 12 didn't come easy. Deep into Stage 2 of the 2015 Tour de France, racing down dead-straight roads on the Dutch coast—between windmills as high as office buildings and the great expanse of the North Sea—Adam Hansen (Lotto-Soudal) crashed.

Pinched between the peloton and the side of the road, he lost his battle with the wind and drove his right shoulder into the earth. With a pop, ligaments stretched and then returned to place. The Lotto-Soudal rider got up with a grimace, remounted with a groan, but finished the stage. X-rays that evening showed a dislocated AC joint.

Most riders would have quit. But Hansen was two stages into his 12th straight grand tour, a few weeks from tying Bernard Ruiz's 68-year-old record for consecutive grand tours completed.

The grand tour double may have proven unattainable this season, but Hansen isn't at the top of the GC. His is a different sort of suffering, a different sort of record.

Riding with his shoulder covered in tape, tilted on his saddle to keep weight off his right side, Hansen battled through 19 more Tour stages, across the Pyrenees and the Alps, to tie the record of Ruiz, who raced in the 1950s, when the Vuelta was only two weeks long.

"My body's all twisted," he said in the Alps with three stages to go in the Tour. "With the shoulder injury, I am using different muscles. The injury and bad luck has made this the hardest grand tour for me."

A month after reaching Paris, Hansen clipped in at the start of the Vuelta a España, his 13th straight grand tour stretching back to the 2011 Vuelta. His arrival in Madrid on September 13 set a new mark. But it won't last long. In May, he'll line up at the Giro and try to extend his own personal sufferfest record.

History suggests that the winner of that race won't win the Tour de France, or even start it. But Hansen already knows what he'll be doing come July.

— CALEY FRETZ

TIM DE WAELE (2)

## DOING THE DOUBLE

Winning two grand tours in the same season is a feat only nine men have achieved since grand tours began more than a century ago.

Seven riders have won the Giro and Tour in the same year. Two have won the Vuelta and Tour in the same year, but no one has achieved the Tour-Vuelta double since the Spanish tour was moved from April to August in 1995. Two have won the Vuelta-Giro combo back-to-back in April and May, but only one has won the Giro-Vuelta combo since the Spanish grand tour's date was moved.

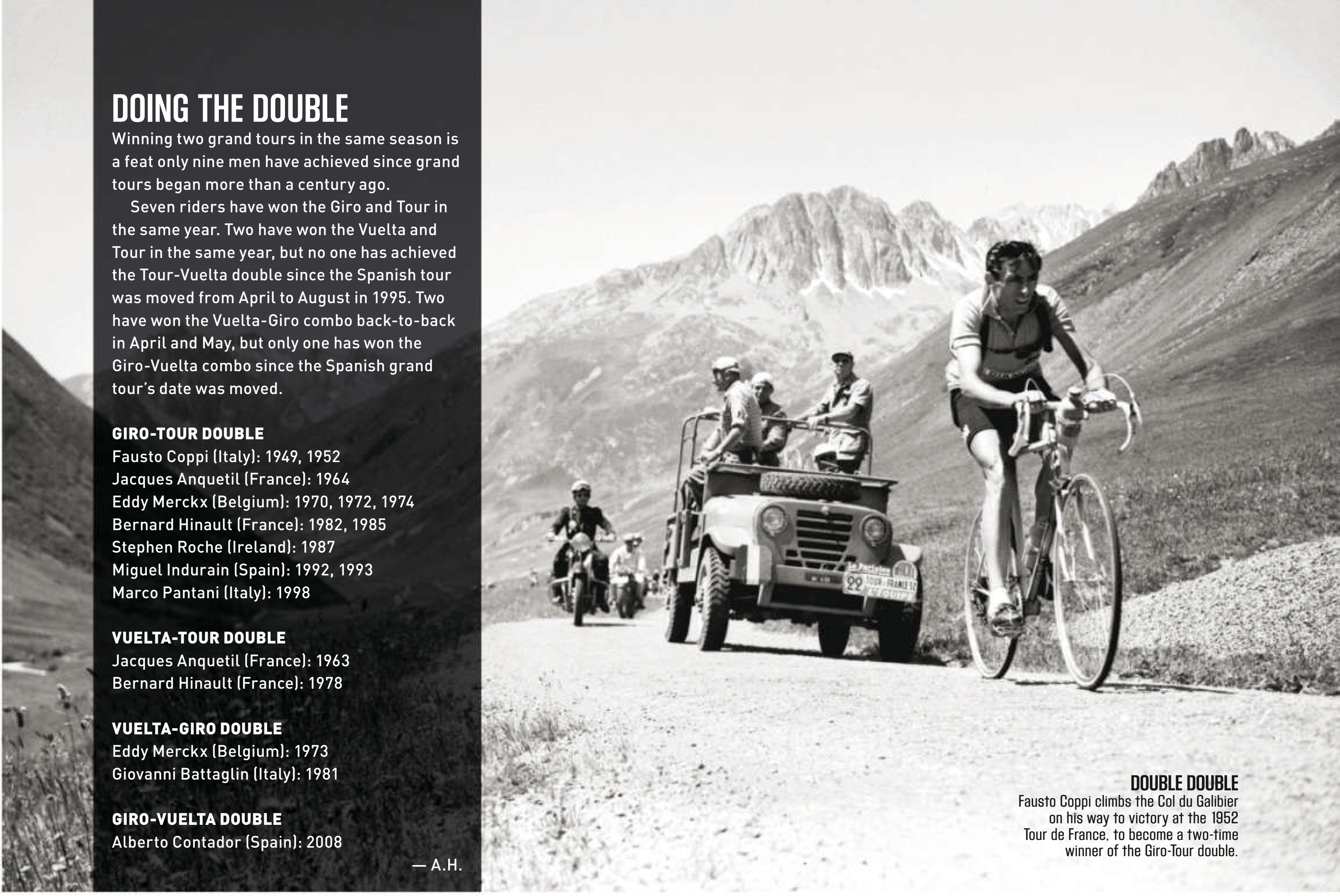
**GIRO-TOUR DOUBLE**
Fausto Coppi (Italy): 1949, 1952
Jacques Anquetil (France): 1964
Eddy Merckx (Belgium): 1970, 1972, 1974
Bernard Hinault (France): 1982, 1985
Stephen Roche (Ireland): 1987
Miguel Indurain (Spain): 1992, 1993
Marco Pantani (Italy): 1998

**VUELTA-TOUR DOUBLE**
Jacques Anquetil (France): 1963
Bernard Hinault (France): 1978

**VUELTA-GIRO DOUBLE**
Eddy Merckx (Belgium): 1973
Giovanni Battaglin (Italy): 1981

**GIRO-VUELTA DOUBLE**
Alberto Contador (Spain): 2008

— A.H.



**DOUBLE DOUBLE**
Fausto Coppi climbs the Col du Galibier on his way to victory at the 1952 Tour de France, to become a two-time winner of the Giro-Tour double.

GETTY IMAGES

"I've never won one grand tour, so don't ask me about winning two in a row," laughs Joaquim Rodríguez (Katusha), second at this year's Vuelta. "What's sure is that you pay for every hard effort. I wasn't at the same level as Quintana or Froome at the Tour this year, but I am feeling great at the Vuelta, and they are the ones who are suffering."

The modern double is more difficult now that the Giro and Vuelta have progressively ticked up the intensity of their routes. Both grand tours are much harder than they were even a decade ago, with more mountaintop finales, harder course profiles, and more intense racing from start to finish. No more four-hour stages at tempo across Tuscany before a tidy bunch sprint.

"The Vuelta is much harder than it was 10 years ago," says Alejandro Valverde (Movistar), third at the Tour and seventh at the Vuelta. "I went so deep to reach the podium this year at the Tour that I had nothing left for the Vuelta."

Another factor making the double more difficult is luck. Avoiding crashes and illness takes a certain bit of good fortune. Nearly everyone agrees that racing in general is more perilous than it was a generation ago, as speeds have increased on roads littered with traffic furniture. The Giro and Vuelta used to have as few as 120 starters. Today, grand tours are packed with 22 nine-man teams. There's not room for everyone at the front of the peloton.

"You need a lot of luck," says Astana's Martinelli. "You see racing these days, with so many crashes, so you need to be fortunate. The good or bad luck is too often the key to how a grand tour turns out."

Today's riders are taking a wider view on the double and see it as a far off mountain, but one that could be summited with the right preparation and flawless fortune.

"The double is an interesting challenge, and maybe it's something I could try later in my career," Froome says. "I would like to win races like the Giro and the Vuelta before my career is over. The Giro-Tour combination is clearly more difficult. The Tour-Vuelta seems more realistic."

There's a general consensus that the Giro-Tour and Tour-Vuelta doubles are the most difficult. The Tour is so demanding that even riders like Froome and Quintana are not fully recovered for the Spanish tour.

The most accessible double is the Giro-Vuelta combo, for logical reasons. Contador did it in 2008, and Aru, second in the Giro and a winner at the Vuelta, almost did it this year.

"The most realistic is the Giro-Vuelta, simply because you obviously have more time to recover between races," says Movistar boss Eusebio Unzué. "And the last one to do that? Contador—that shows his class."

Unzué, who led Indurain to back-to-back Giro-Tour doubles in 1992 and 1993, said he believes riders like Froome and Quintana could achieve the Giro-Tour someday but added the Tour-Vuelta will likely be knocked off first, simply because sponsors demand that the star riders take on the Tour at full strength.

Yet it might be Vincenzo Nibali (Astana) who could take the Giro-Tour as soon as next season. Martinelli confirmed to *Velo* that Nibali is all but sure to race the Giro in 2016, and added they will make the decision on whether or not he'll race the Tour if and when he wins the pink jersey.

It's all about gaining a place in history.

# TOP-SPEED INTERNS

NILS POLITT

# Inside the high-stakes world of the ‘stagiaire’

BY ANDREW HOOD | BURGOS, SPAIN

**PELOTON APPRENTICES**
Nils Politt graduated from his Contintental team to the big leagues with Team Katusha. Likewise, Restrepo's road to the WorldTour started with a stint as a stagiaire for the Russian team at the Vuelta a Burgos.

COR VOS: COURTESY TEAM KATUSHA

JHONATAN RESTREPO WAS TRYING TO hold back his smile. The 20-year-old Colombian didn't want to look giddy, not in front of seasoned pros like Dani Moreno and Ángel Vicioso, who were his new teammates on Team Katusha. But he couldn't help it.

It was a baking 98-degrees-in-the-shade day in mid-August, and Spain's northern meseta was sweltering. The Vuelta a Burgos featured a decisive 13.1km team time trial in stage 2, and the Katusha riders were trying to stay cool while warming up on the rollers. A soigneur slipped an ice vest around Restrepo's slender shoulders. “How's that feel?” he asked.

Ice vests, which cool core body temperatures and allow riders to perform better in the heat, are commonplace in the pro peloton. But Restrepo had never seen one, let alone worn one. When would he have? He had never been in the pro peloton. He was a stagiaire, an intern on two wheels getting his chance to impress would-be employers at the next level.

As the soigneur adjusted the ice vest, Restrepo couldn't hold back any longer. A smile crept across his face.

At the five-day Vuelta a Burgos, Restrepo's apprenticeship was intense. He was one of two Katusha stagiaires getting a taste of the WorldTour. The other was 21-year-old Nils Politt, considered one of the most promising German talents in a generation.

They were among dozens of similarly skinny, nervous, yet ambitious amateurs hoping to graduate to the highest echelons of cycling. Their sink-or-swim story repeated itself across WorldTour, Professional Continental, Continental, and women's teams, which can add amateur and under-23 riders to their respective rosters after August 1 each season, so long as they have not raced at the elite level before. According to a list compiled by procyclingstats.com, there are 87 registered stagiaires for 2015, with 33 spread among WorldTour teams.

The stagiaire (French for “intern”) system dates to 1996, when the UCI eliminated the amateur classification and created the U23 category. It was the same year that professionals were allowed to compete in the Olympic Games in Atlanta for the first time. As teams grew and the sport expanded, it was necessary to offer an entry point into the peloton for promising amateurs.

The idea is simple enough. It's akin to the junior varsity squad participating in varsity football practice. “Having stagiaires is a good thing,” says BMC Racing general manager Jim Ochowicz. “It allows younger riders to get into the pro peloton without making the commitment to turn pro, and it gives the teams a way to explore young talents. We always bring on a few riders to try out each year.”

Like most WorldTour teams, BMC Racing has an established stagiaire program and brought on three young riders to test in 2015. The teams like their interns because they're not paid—though the free bikes and kits are compensation in and of themselves—and they help fill out rosters that can be short on healthy, motivated, and race-fit bodies late in the season.

Under UCI rules, WorldTour teams can take up to three stagiaires each season, but the newbies cannot race at WorldTour events. Their tryouts are limited to secondary races on the international calendar.

Perhaps it was a bit cruel for Katusha to throw Restrepo into the Vuelta a Burgos. It's not an easy race by any definition, with four WorldTour teams in the field and a peloton packed with riders either coming from the Tour de France or building for the Vuelta a España. Adding to the stress were two major mountaintop finales and a very technical, high-speed team time trial.

Moments after his warm-up, Restrepo joined his new teammates on the TTT course. Katusha finished fourth on the day, and Restrepo, a seven-time junior world champion on the track, was able to hold his own. “I'm excited to be here with a team like Katusha,” Restrepo said. “It's a

**IF YOU CAN'T BEAT 'EM, BUY 'EM** At the Tour de San Luis in January, Colombian Fernando Gaviria beat Mark Cavendish to win stage 1. By September, Gaviria was a member of the same Etixx-Quick-Step team as Cav and was winning stage 4 of the Tour of Britain (below).

nice opportunity to try and show what I can do. I am not too worried."

Like most of the other stagiaires, Restrepo is a highly touted amateur, having won the U23 road title at the Pan-American Games in May. He's the latest in the Colombian talent pipeline that's fueled the South American resurgence over the past five years. Other Colombians who've recently ridden as stagiaires and then made the jump to the pro ranks include Sebastián Henao (Sky); Esteban Chaves (Orica-GreenEdge), who had a breakout performance at the Vuelta a España; and Miguel Ángel López (Astana), who has been compared to Nairo Quintana.

Restrepo survived the heat, stress, and nerves to notch 18th in the third stage and finish 50th overall, just behind Paris-Roubaix winner Johan Vansummeren and ahead of 2002 Giro d'Italia winner Damiano Cunego.

"We don't expect them to win, of course," says Katusha sport director José Azevedo. "We bring stagiaires on to see other things—how they fit into the team, how they react in the race, how they handle themselves at the dinner table."

Sometimes a stagiaire does win, though. Fernando Gaviria, the young Colombian sprinter who beat Mark Cavendish at Argentina's Tour de San Luís in January, was picked up by Etixx-Quick-Step late this season and won stage 4 at the Tour of Britain in September—against André Greipel (Lotto-Soudal) and Edvald Boasson Hagen (MTN-Qhubeka).

About one-third to one-half of all stagiaires land with a major team. For those who miss out on a pro deal the first time around, it's not the end of the world. They can continue to race at the amateur level, join another team, and even be a stagiaire again the following season. There is no established road into the pro peloton.

"It's a big opportunity, but there's some pressure there, too," Ochowicz says. "It's a wake-up call for some of these guys. You look over your right shoulder, and you see Contador there. It gives the teams a chance to see how they react."

Some young riders are so talented and

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**ONE OF THEM**
Larry Warbasse raced as a stagiaire for BMC in 2012 before joining the team full-time the next season.

COR VOS

> "I had already signed my contract, and I knew I was going into the pros, but riding as a stagiaire was a nice way to get my feet wet before I jumped headfirst into the next season."
>
> **— LARRY WARBASSE**

mature they don't need to bother with being a stagiaire. Caleb Ewan, the 21-year-old Aussie sprinter who won a Vuelta stage in 2015, in his grand tour debut, turned professional last summer with Orica-GreenEdge, which allowed him to race at the WorldTour's Tour of Beijing in 2014. Lawson Craddock, a product of the U23 program at USA Cycling, went from the amateur ranks straight to Giant-Alpecin as a pro in 2013.

Many stagiaires, such as Lotto-Soudal's Tiesj Benoot, who finished fifth in his Tour of Flanders debut this season, come on board after they have a contract already in their pocket. That's how Larry Warbasse (IAM Cycling) did it, riding as an apprentice at the end of 2012 before joining BMC full-time in 2013.

"I had already signed my contract, and I knew I was going into the pros, but riding as a stagiaire was a nice way to get my feet wet before I jumped headfirst into the next season," Warbasse says. "You get a taste of what pro racing is like, and a sense of what it's like to work with the team. It really set me up well for the next season."

At the end of 2012, Warbasse raced the Tour of Utah as well as some European races, including the GP de Wallonnie, the four-stage Eurometropole Tour, and Paris-Tours. He says racing at that level was a nice way to transition toward the higher demands of the WorldTour.

"The transition wasn't too bad as a stagiaire," Warbasse says. What was crazy was the next year at the WorldTour. The racing in Europe at the 2.2 or even the 2.HC level [stage races below WorldTour classification], those races are at a good level, but you see that level even racing for the national team. The WorldTour level is a huge step up. Because of the speed, and the depth of the field, everyone is just suffering the entire race."

Most of the major WorldTour teams have established stagiaire programs that bring in two or three riders each summer, often with a domestic focus. Typically, Spanish teams have tapped Spanish riders, and French teams have gone after promising national talent. But that's changing. Katusha's reach into Colombia and Germany reflects the ever-expanding breadth of the talent pool. The hunt has gone global.

"We keep an eye on young talent all year long, all over the world," Azevedo says. "We watch the world championships, the track, the U23 races. You don't want to miss a promising rider just based on their passport."

By mid-September, most teams are confirming their rosters for the following season. This year, as expected, some of the more high-profile stagiaires already had their contracts for 2016. Gaviria had signed with Etixx-Quick-Step and Jack Haig with Orica-GreenEdge.

On September 11, Katusha confirmed the arrival of established pro Jurgen Van Den Broeck from Lotto-Soudal as well as a pro contract for Politt, who had impressed Katusha management with his results, including the German U23 time trial title, second place in the U23 road race, and sixth overall at Bayern Rundfarht.

"I am so happy that Katusha wanted me," Politt says. "They already showed interest in me several months ago, and I am sure I will learn a lot with this team."

One week later, team officials confirmed that Restrepo would also join the team in 2016.

"To sign a contract with Team Katusha is like a dream come true for me," Restrepo says. "I could already feel the atmosphere when I participated with them at the Vuelta a Burgos. The teammates all accepted me and gave me so much valuable advice. 'Purito' Rodríguez has always been a kind of hero to me. I look forward to racing in Europe next year. It will be a long way to go, but I am motivated and prepared to listen and work for the others. Stage races or classics, I want it all."

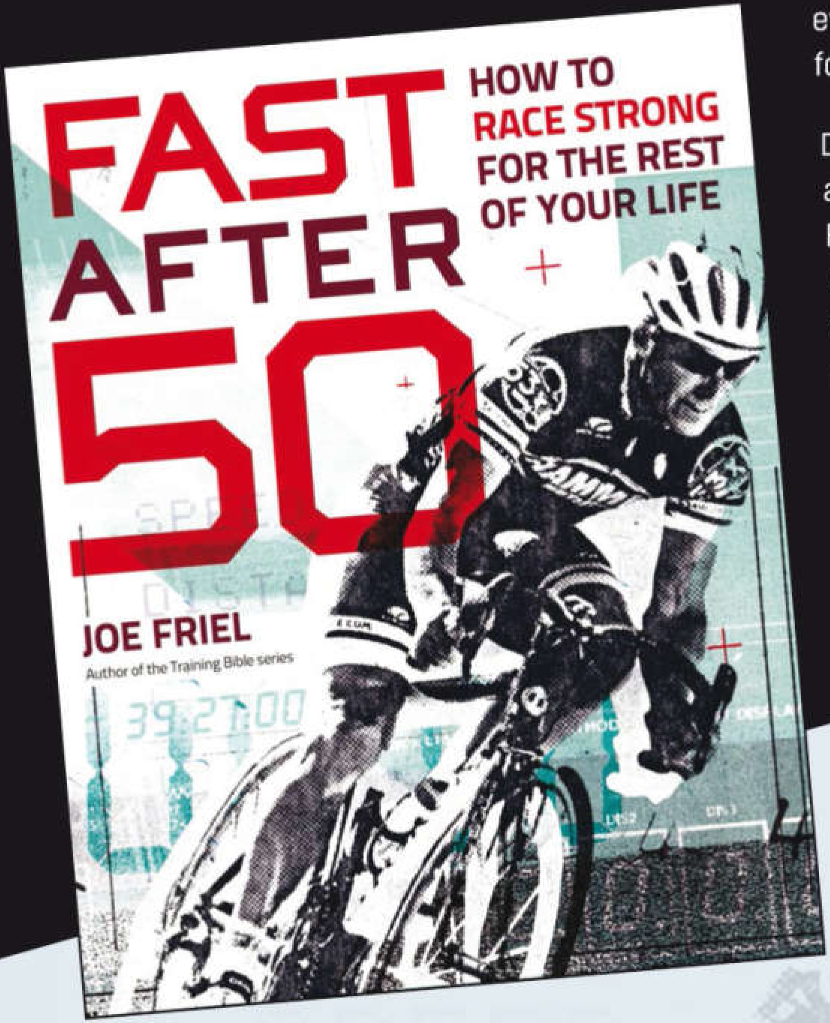
The team praised the young Colombian, noting that his time with the team at Burgos was what made the difference in their decision to sign him.

"He has so many skills. That's what I like in this rider," says team manager Viatcheslav Ekimov. "He can climb, he is fast, and he is a good TT rider. Most of all, his attitude in the Vuelta a Burgos convinced us. He worked hard for Dani Moreno. He was immediately 'part of us.' Jhonatan is the first-ever Colombian rider in Team Katusha. It makes it extra special for us. We are proud to have him with us and we will patiently let him grow in our team."

For the hopeful pros like Politt and Restrepo, stagiaire season is their first real taste of the brutality, savagery, and unforgiving nature of the pro peloton. It also gives them a glimpse of the money, success, and lifestyle they can enjoy if they make it to that level.

"That first pro contract is the hardest step," Ochowicz says. "A lot of things have to click into place. Maybe it's the wrong fit for us, but not some other team. Young riders only have a few years to turn pro. And then the next big step is establishing yourself as a pro."

# DON'T SETTLE FOR SLOW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CONTINENTAL

# WHERE THE RUBBER MEETS THE ROAD

## We took 34 popular road tires into the lab to find out which ones were fastest—and why.

BY LENNARD ZINN

BRAKETHROUGH MEDIA; COURTESY WHEEL ENERGY

**WHAT MAKES A TIRE FAST?** We went to Nastola, Finland, to find out. There, in the labs of Wheel Energy Oy—the best facility in the world for evaluating rolling resistance—we tested 34 tire models to separate the hype from the science. (See page 57.)

Pushing a road bike at 40 kilometers per hour on a flat road demands power output in the range of 270 to 350 watts for most cyclists. Wind resistance takes up most of that. But the second largest constituent of drag is rolling resistance. Two tires with a rolling resistance of 50 watts each will eat up 100 watts to hold a 40kph pace. No wonder you feel so slow on touring tires.

What we found out: While supple and wider tires roll fast, tread compound is paramount. Like most cyclists, we assumed that a fine-thread, non-vulcanized casing (its thread is spiral-wrapped around a drum with only raw liquid latex brushed over it and no heat added) would offer the least rolling resistance. But only one of the top five tires in the test was a non-vulcanized open tubular. The other four were fully vulcanized (the entire tire is cooked in a mold, melting the rubber throughout all of the layers) with casings strung on a “calendar” (a big loom on which rubber is pressed into the fabric).

So if you’re looking for a fast tire, don’t be afraid to go wide, and don’t blindy follow conventional wisdom about compounds and tubes. The fastest tire in our test—the Specialized S-Works Turbo Road Tubeless—was vulcanized and full of sealant.

It’s striking to see that four of the top five tires in our test come from Specialized. But the truth is that all five come from the same tire design team. The 25-millimeter Continental GP 4000S II—one of the world’s best-selling high-end clinchers for years—was created by the same engineers now running tire development for Specialized.

Here’s what we learned about our 34 test subjects—and tires in general.

## HOW WE TESTED

Wheel Energy evaluates bike tires on a 1,200-millimeter-diameter drum with an interchangeable surface. To simulate an average asphalt road, they use a steel surface with a diamond-plate tread pattern like you might find on metal stairs.

The tires ranged in width from 22 to 26 millimeters and included standard clinchers, open tubulars, and tubeless versions. We tested them at 40 kilometers per hour with a load of 50 kilograms, each inflated to 116psi. To simulate the way we assumed most people will run these various models, we used 70-gram Bontrager XXX latex inner tubes in higher-end clinchers and 95-gram butyl tubes in less expensive ones. Tubeless tires took 25 grams of Bontrager TLR sealant.

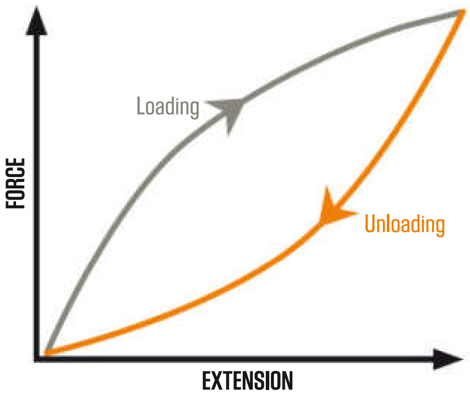
All standard clinchers were mounted to Mavic Ksyrium SL wheels, while tubeless tires went onto Fulcrum Racing 1 wheels.

Wheel Energy has a rigorous calibration protocol that the company claims delivers an accuracy of ± 0.15 watts. This involves starting up the machine 12 hours before testing begins to bring the drum and room up to a standard temperature. Technicians then take three test measurements with three known tires to check for consistency. Finally, each tire runs for 10 minutes on the drum before any measurements are taken, to warm up, settle the tire shape, and work out internal stresses. The calibration procedure means the lab can test only two tires per hour.

Though Wheel Energy has found that the difference between two tires of the same model is rarely more than 0.1 or 0.2 watts, we tested two tires for each model and averaged the results. So we spent one hour testing each model in our lineup.

Figure 1

### HYSTERESIS LOOP



## COMPOUND IS PARAMOUNT

Rubber compounding is the inexact science of mixing together different organic polymers and, often, inorganic compounds. Tire companies tend to hold their proprietary formulas as closely guarded secrets.

One way in which car companies have achieved reductions in average fleet fuel efficiency is by using tires with lower rolling resistance. Tire companies have begun incorporating more synthetic rubber into their compounds and adding silica to decrease rolling resistance without sacrificing traction. Silica reduces the amount of internal friction in the rubber, which is key. All rubber loses energy due to internal friction when it is deflected, since the energy required to deform rubber is greater than that required to return it to its original shape. This is why each bounce of a ball is lower than the prior one.

Consider a graph of the extension of a rubber compound versus the force stretching it. As the rubber is loaded under increasing force, the curve starts out steep then levels off, meaning the rubber initially holds its shape but then gives into increased force. When the load is released, the rubber again tries to hold its shape. It is initially slow to respond and then rapidly returns as the last bits of the load are removed.

This lag in the deflection response is called hysteresis, and it results in a graph that looks like convex lenses tilted up to the right. (See figure 1.) The amount of energy loss is equal to the area in the center of this “hysteresis loop.” The faster the compound, the smaller the loop. The smaller the loop, the faster the tire.

How did compounds play out in our test? While the 24-millimeter Specialized Turbo Cotton open tubular was basically a rounding

COURTESY WHEEL ENERGY (2)

error away from being tied for first, it's worth noting that the winner, the 26-millimeter S-Works Turbo Road Tubeless, was three watts faster than its 24-millimeter sibling. So it's a safe bet that a 26-millimeter version of the Turbo Cotton would have been a clear winner.

The Turbo Cotton's performance is a function of compound and casing. Specialized has several compounds under the Gripton moniker. The actual compound material varies depending on tire model and application. The Turbo Cotton is the only tire in the top four with a width under 25 millimeters. It has Specialized's fastest, most responsive (low-hysteresis) Gripton compound in the center tread. In the shoulders, it has a compound with higher-hysteresis polymers to maintain grip and provide a dampened, secure road feel.

The latex impregnation of the supple, 320-TPI, non-vulcanized cotton casing material ensures that it has very low hysteresis. Nylon or polyester casings with cured (vulcanized) rubber melted through the casing have higher hysteresis and, hence, higher energy loss.

So the Turbo Cotton was the fastest clincher in our test and also boasts a shoulder tread compound that provides outstanding grip. Speed is nothing without control.

The 26-millimeter S-Works Turbo Road Tubeless has a lightweight 180-TPI vulcanized nylon casing and low-rolling-resistance Gripton tread. This, plus the lack of inner-tube friction, helped it achieve the top spot.

Specialized's first branded products were tires, and the company has invested heavily over the past few years to greatly improve its offerings in this category, notably by hiring two German engineers away from Continental to run its tire division: Wolf Vorm Walde, tire research and

# HOW THEY PERFORMED

| RANK | TIRE | TYPE | WIDTH (mm) | WEIGHT** | TPI | INNER TUBE | PRICE | WATTS* |
|---|---|---|---|---|---|---|---|---|
| 1 | Specialized S-Works Turbo Road Tubeless | tubeless | 26 | 280 | 180 | none | $100 | **31.6** |
| 2 | Specialized Turbo Cotton | open tubular | 24 | 220 | 320 | latex | $80 | **31.7** |
| 3 | Specialized S-Works Turbo | vulc. clincher | 26 | 220 | 120 | latex | $55 | **32.8** |
| 4 | Continental GP 4000S II | vulc. clincher | 25 | 230 | 165*** | latex | $70 | **34.0** |
| 5 | Specialized S-Works Turbo Road Tubeless | tubeless | 24 | 280 | 180 | none | $100 | **34.9** |
| 6 | Zipp Tangente Speed | open tubular | 25 | 190 | 220 | latex | $75 | **35.7** |
| 7 | Bontrager R4 Aero | vulc. clincher | 22 | 170 | 220 | latex | $80 | **36.6** |
| 8 | Schwalbe ONE | vulc. clincher | 25 | 225 | 127 | latex | $80 | **38.0** |
| 9 | Schwalbe ONE tubeless | tubeless | 25 | 340 | 127 | none | $81 | **38.2** |
| 10 | Vittoria Corsa EVO CX | open tubular | 23 | 219 | 320 | latex | $75 | **38.5** |
| 11 | Veloflex Corsa | open tubular | 25 | 205 | 320 | latex | $75 | **39.7** |
| 12 | Challenge Strada | open tubular | 25 | 240 | 300 | latex | $71 | **39.9** |
| 13 | Schwalbe ONE | vulc. clincher | 23 | 205 | 127 | latex | $78 | **40.7** |
| 14 | Veloflex Corsa | open tubular | 23 | 195 | 320 | latex | $75 | **40.8** |
| 15 | Challenge Elite | open tubular | 25 | 240 | 260 | latex | $55 | **41.1** |
| 16 | Specialized Turbo Pro | vulc. clincher | 24 | 240 | 60 | butyl | $40 | **41.4** |
| 17 | Challenge Criterium | open tubular | 23 | 205 | 320 | latex | $75 | **42.3** |
| 18 | Challenge Elite | open tubular | 25 | 240 | 260 | butyl | $55 | **42.4** |
| 19 | Hutchinson Fusion 2 | tubeless | 23 | 290 | 127 | none | $43 | **42.5** |
| 20 | Tufo Calibra racing tyre | vulc. clincher | 23 | 205 | 120 | latex | $48 | **42.9** |
| 21 | Tufo Calibra Plus Racing tyre | vulc. clincher | 23 | 180 | 120 | butyl | $52 | **43.9** |
| 22 | Hutchinson Atom Comp | vulc. clincher | 23 | 190 | 127 | latex | $70 | **43.1** |
| 23 | Bontrager R3 TLR tubeless ready | tubeless | 23 | 265 | 120 | none | $90 | **45.2** |
| 24 | Challenge Criterium | open tubular | 25 | 215 | 320 | latex | $75 | **45.3** |
| 25 | Hutchinson Fusion 3 | tubeless | 23 | 295 | 127 | none | $105 | **45.5** |
| 26 | Continental Grand Sport Race | vulc. clincher | 25 | 250 | 120*** | butyl | $40 | **46.1** |
| 27 | Michelin Pro 4 Service Course Black | vulc. clincher | 25 | 215 | 110 | latex | $70 | **46.6** |
| 28 | Vittoria Rubino Pro | vulc. clincher | 23 | 225 | 150 | butyl | $44 | **47.0** |
| 29 | Zipp Tangente Course | vulc. clincher | 25 | 215 | 120 | butyl | $55 | **47.5** |
| 30 | Michelin Lithion 2 | vulc. clincher | 25 | 250 | 60 | butyl | $40 | **48.5** |
| 31 | Hutchinson Intensive | tubeless | 25 | 315 | 127 | none | $100 | **48.6** |
| 32 | Bontrager AW 3 | vulc. clincher | 23 | 295 | 120 | butyl | $60 | **51.8** |
| 33 | Hutchinson Fusion 3 | vulc. clincher | 23 | 210 | 127 | butyl | $45 | **53.3** |
| 34 | Schwalbe Durano | vulc. clincher | 25 | 245 | 67 | butyl | $57 | **59.2** |

*Power required to spin tire at 40 kilometers per hour with a 50-kilogram load. **Manufacturer claimed weights in grams. ***Corrected to use standard method of TPI measurement.

development director, and Wolfgang Arenz, compound specialist.

"The tread area is where the most deflection in a tire occurs," Vorm Walde says. "That is where the rolling resistance is created. We have a significant advantage in compounding."

## SUPPLE CASINGS REDUCE ROLLING RESISTANCE BUT CANNOT MAKE UP FOR BAD COMPOUNDS

All tires have multiple layers of threads holding things together. Two sheets of unidirectional threads laid across each other at right angles generally counts as one layer. Tire casings are specified in TPI (threads per inch) per sheet. The higher the number, the thinner the threads, since more of them can be crowded together.

Comparing TPI isn't merely a matter of comparing thread counts, however. It should be, but Continental counts things differently, which makes apples-to-apples comparisons difficult, at least when Contis are thrown into the mix. The company adds the TPI of each sheet within a layer. So a 165-TPI casing, like on the GP 4000S II, gets marketed as 330 TPI. This is misleading and renders the TPI number meaningless, because, obviously, the number gets higher by piling more layers atop each other, making the tire stiffer, rather than more supple, as a high-TPI number should indicate.

But the great performance of open tubulars in our test shows that a high TPI (correctly counted) does deliver a faster tire. The 24-millimeter Turbo Cotton was second by a very fine thread. And the fastest tire not developed by one of Specialized's Wolfs is also an open tubular—the 25-millimeter-wide Zipp Tangente Speed.

However, open tubulars from Vittoria, Veloflex, and Challenge ranked down with several vulcanized tires. What gives? We assume those results are due to inferior tread compounds. Even within the same company, compounding can vary greatly between models. The 265-TPI polyester/cotton casing of the Challenge Elite isn't as supple as the 320-TPI cotton casing of a Challenge Criterium, yet the former is four watts faster at the same width. Compound is the only explanation.

## TUBELESS ROAD TIRES DO NOT NECESSARILY HAVE LOWER ROLLING RESISTANCE

We had expected tubeless or tubeless-ready tires to have lower rolling resistances, since inner tubes create friction and should, thus, raise rolling resistance. Indeed, our top performer was a lightweight tubeless tire. Overall, though, our test didn't show tubeless-ready clinchers to have lower average rolling resistance than standard clinchers except on a completely smooth drum, which is a totally unrealistic riding surface.

**NUMBERS DON'T LIE**
Specialized's tire team is making the fastest clinchers and open tubulars on the market.

BRAD KAMINSKI

On rough surfaces, where imperviousness to thorn punctures and pinch flats—when used with sealant—makes tubeless tires particularly attractive, they were not always faster. A 25-millimeter Schwalbe ONE clincher with a latex inner tube, for example, had essentially the same rolling resistance as a 25-millimeter Schwalbe ONE tubeless. This is likely due to the fact that tubeless tires need a thicker layer of rubber inside the casing to hold air. Their weight is therefore comparable to a similar clincher plus inner tube.

Also, tubeless and tubeless-ready tires cannot be open tubulars; they are always vulcanized to create an airtight casing and seal along the tire bead.

## THE STIFFER THE TIRE, THE MORE AIR PRESSURE MATTERS

Many riders obsess over tire pressure. But it turns out that there is less need for that with

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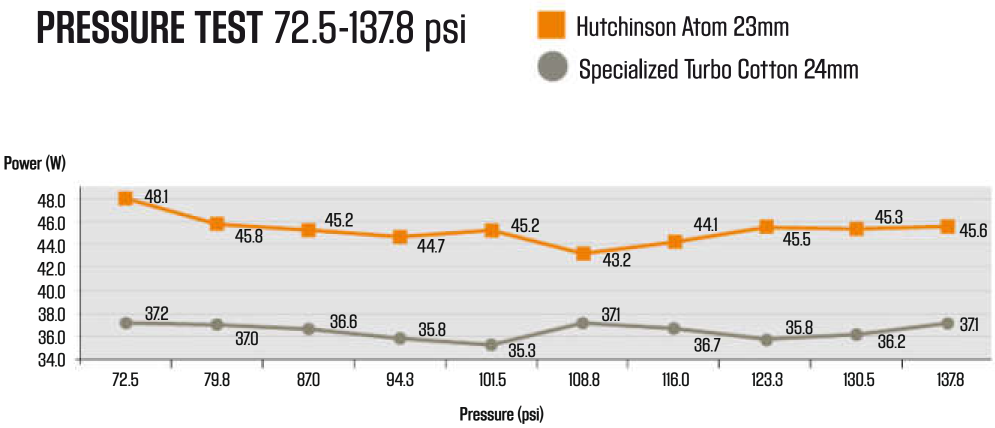
Figure 2

**PRESSURE TEST** 72.5-137.8 psi



better tires. Conversely, if the casing is bad, the tire will be slow, regardless of pressure. Lower pressures may feel smoother, but dropping from, say, 109 to 73 psi in a slower, vulcanized tire, is a five-watt penalty per tire. With an open tubular, the difference is negligible.

Lower tire pressure means fewer pounds of pressure on the tire. Since the tire is supporting the same load regardless, the contact patch will be bigger at lower pressures. Wheel Energy measured a 75-millimeter-long footprint for a 700 X 23 tire inflated to 112 psi with a 50-kilogram load. At 84 psi, the patch grew to 82 millimeters.

The larger contact patch at lower pressure means tire deflection will be deeper, resulting in more internal-friction (hysteresis) losses. That would seem to argue for higher pressures. And, indeed, if you were riding on smooth glass, higher pressure would be faster. Wheel Energy did a smooth-drum test of the 22-millimeter track tubulars *VeloNews* managing editor Chris Case used for his hour-record attempt and found that rolling resistance continued to drop as pressure increased from 101 psi all the way up to 203 psi.

On rough surfaces, however, a tire at lower pressure is better able to absorb bumps, rather than deflecting the entire bike and rider upward, as it would if it were pumped up harder. This is the same sprung-versus-unsprung-weight argument that explains why suspension makes a vehicle faster on rough terrain: The less weight is sent upward with each bump, the less less energy it takes to keep the bike rolling.

So what is the ideal pressure for the surface you'll be riding on? There is a sweet spot, but it's a big one, and it depends—of course—on the type of tire you're running. Supple, unvulcanized, high-thread-count open-tubular tires have much more wiggle room than stiffer vulcanized tires.

In our pressure test of the Specialized Turbo Cotton versus the Hutchinson Atom, a 36-psi drop in pressure in the former had about the same penalty as just a 7-psi drop in the vulcanized Atom. (See figure 2.) One important takeaway from that: Latex inner tubes lose more air over the duration of a race than butyl tubes. But if you're running fast tires, that won't matter.

## WIDER TIRES ARE FASTER

Tire rolling resistance comes from internal friction within materials (energy loss due to hysteresis) and small bumps that lift the bike and rider.

When it comes to internal friction, wider tires have shorter contact patches and, thus, less deflection. If pressure is the same, the area of the contact patch must be the same to support the same load. (Since both load and pounds per square inch remain constant, the area in contact with the road will also be the same.) But a wider, shorter contact patch will have less vertical depth of deflection, so internal friction and hysteresis loss will be lower.

If a wider tire is constructed of the same materials in the same thicknesses as a narrower one, it will often roll faster on a rough surface, despite being heavier. This is due to both lower internal friction and the fact that the wider tire will better absorb imperfections in the road, thus lifting the bike and rider slightly less on each little impact.

## THE BOTTOM LINE

If you want reliability and good rolling resistance, wide tubeless tires with sealant are the way to go. If punctures are not an issue, and you want pure speed and grip without having to worry too much about tire pressure, go with an open tubular with a great tread compound. **V**

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# RELAX AND RECOVER

## The art of resting as hard as you ride

By Trevor Connor

**THE HOUR AFTER A LONG RIDE WAS ONCE** my favorite thing in the world. I'd come home, make myself a giant smoothie, watch a TV show I'd never admit to enjoying, and relax with a good stretch. But in the year I was both a rider and team manager, things had to give. I lost that hour-after routine. I was still able to stretch, but I fit it in while doing other things.

Something strange happened that year. My calves started to cramp, and I struggled to push myself on rides. It became an issue that dogged my entire season and only cleared when I finally found those relaxing hours again. Apparently, I needed more than the stretch.

Athletes use a variety of techniques to aid recovery, including stretching, foam rolling, non-steroidal anti-inflammatory drugs (NSAIDs), compression clothing, ice baths, and calorie replacement, among many others. It can all add up to a lot of time and money. But it's an investment we all seem willing to make. Is it worth it?

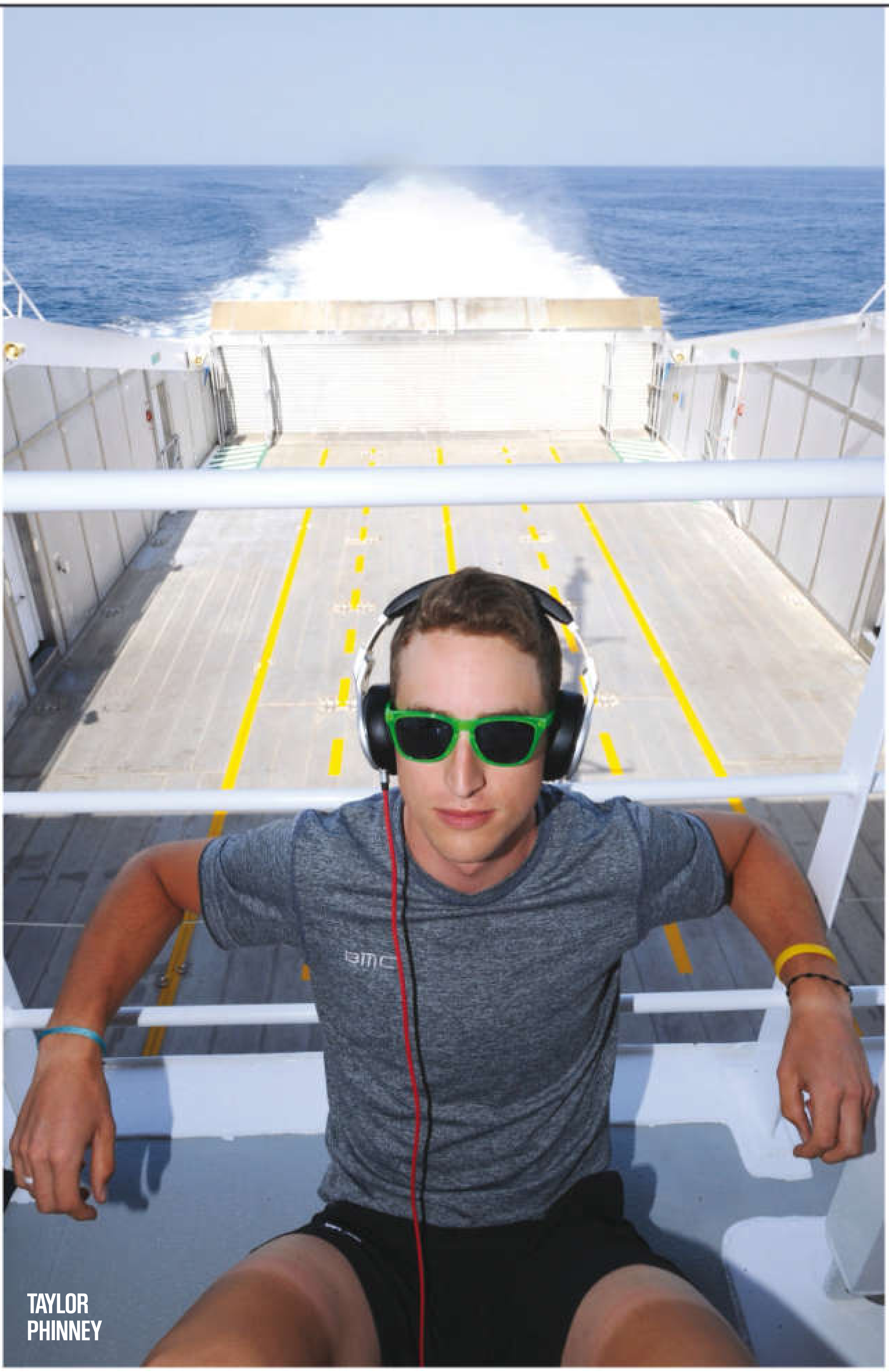
Many recent scientific reviews, including a 2015 analysis led by Dr. Andrew Peterson, the director of primary care sports medicine at the University of Iowa, found little evidence to support many of these techniques. And that may actually be exaggerating the benefits, according to Peterson, who feels a lot of studies with negative results never get published. "If they did, we'd see even less effect," he says. Some recovery tools, such as heat and NSAIDs, may even hurt performance.

But before you throw out the foam roller, Peterson warns that the lack of evidence may be a research issue. The only way to truly determine if a recovery tool works is to look at its effect on performance. But there's no big money in recovery, so it doesn't command the hefty research budgets. Without expensive population-based studies, direct conclusions about its effects on performance are not so simple. "Improvements in performance are either so subtle that you can't detect them or they're frankly not there," Peterson says.

Instead, we have to rely on indirect markers of recovery. The two most common are lactate clearance and delayed-onset muscle soreness (DOMS). Lactate naturally returns to baseline levels within 90 minutes, making it a poor measure of long-term fatigue. And DOMS, which is caused by performing unfamiliar eccentric exercises, isn't something trained athletes normally encounter. This is especially true with cyclists, since riding a bike is not an eccentric activity. (Eccentric exercises involve lengthening a muscle under load, like lowering a dumbbell during a curl.)

"DOMS doesn't really happen in cycling," says Dr. Ben Rattray, an assistant professor at the University of Canberra Research Institute for Sport and Exercise, where he researches sports physiology. "So why treat it?"

Furthermore, a 2014 review out of Queensland University of Technology found


TAYLOR PHINNEY

TIM DE WAELE

that the time course of recovery from DOMS didn't match up with the recovery of muscle strength and prior performance levels.

What did match up was EMG activity. There was reduced brain activity during the fatigue stage, indicating a lowered "neural drive" that returned to normal along with the athletes' strength and performance levels.

One athlete who seems to have found his way to that on his own is Taylor Phinney, who says he focuses "more towards the mental side of recovery" and feels that emotional and psychological rest is more important than any technique. "No one likes ice baths," Phinney says. "You just went training for a long time and you were just uncomfortable. So why would you make yourself more uncomfortable?"

Still, according to Rattray, we haven't necessarily gone in the wrong direction with current recovery techniques. "I just think maybe we haven't thought about all the options," he says. It may be that research shows few benefits because it has focused solely on peripheral recovery.

In fact, Phinney could be off about the ice baths in some circumstances. A 2013 study published in the *Journal of Applied Physiology* that tested cyclists who raced in the heat found that cold-water immersion restored Beta activity in the brain, the loss of which has been associated with fatigue. So ice baths, which athletes use to reduce core temperature, might have indeed been helpful all along, just not in the way we thought. If more research began to look at the neural effects of recovery techniques, scientists might discover what's really going on.

There is one recovery technique with proven peripheral gains: The restoration of muscle glycogen through consumption of simple carbohydrates soon after exercise or competition is indisputable. "For me, a sport like cycling is about restoring energy," Rattray says. "But what we've probably neglected is that the brain uses fuel, as well. Staying motivated is actually a high-fuel task for the brain. Depleting that fuel has been shown to lower a rider's drive and hasten the time to exhaustion."

Ironically, the newest side of recovery science may actually take us back to the oldest techniques. "I think a lot of real recovery is about what you eat every day, and the sleep that you're getting," Peterson says. As Phinney points out, some people's recovery process is what is hampering their ability to relax and recover. In other words: If you're stressing out about recovery, you won't recover. You may be best advised to take a nap.

## All in your mind

**Many cyclists swear by their own unique recovery routines, but that's often based on trial and error and a sample size of one—hardly scientific. If you're looking for some guidance to develop a more deliberate plan, our experts have some advice.**

### LET THE BODY DO ITS THING

Evolution has created some very sophisticated recovery tools within humans that make the body pretty good at repairing itself. Sometimes recovery tools just hinder that process. Peterson points to NSAIDs and heat as examples. Heat, such as saunas, can promote edema and the accumulation of stress proteins which may slow recovery. There is evidence that NSAIDs may "impair healing of bone and tendons" and block pain-promoting cyclooxygenase. The problem is this compound is also critical for muscle repair. Peterson limits their use among the athletes at the University of Iowa.

### BUILD THE BODY'S RECOVERY STRENGTH

Rattray will soon publish a study showing that elite cyclists are more resistant to mental fatigue than amateurs. Phinney agrees that cyclists build the body's natural recovery ability over time. "You're not going to need to do so many of these things, like ice baths and compression," he says. You can buy the same tools they use, but until you've invested in years of riding like a pro, you're simply going to need more recovery time.

### TRAIN THE BRAIN

Just as we can build endurance on the bike, Rattray feels we can build our brain's mental resilience. "Engaging in cognitive activities while doing your physical training seems to have quite large positive effects," he says. Rattray recommends playing with some of the brain training apps on your phone while sitting on your trainer in the winter.

### DISCONNECT THE BRAIN

If Phinney could only offer one recovery suggestion it's to "disconnect yourself from overthinking things," he says. "Connect with people and work on things that make you happy." Rattray agrees. "Don't engage in mentally exhausting activity," he says. "Emotion is particularly draining." Watching a movie or listening to music will slow the mind and help it refuel.

### SLEEP

"Taking a nap after a ride is my best, most favorite recovery," Phinney says. He recommends limiting it to 20 minutes. Our brains restore their fuel during sleep, and our muscles do most of their repair at the same time. Peterson says a recovering athlete can't get too much sleep.

### REFUEL

Restoring muscle and brain glycogen is one of the most effective recovery strategies you can employ. Eat about 1.2 to 1.5 grams of carbohydrates per kilogram of body weight immediately after exercise. "Adding a little protein may also reduce brain fatigue," Peterson says. It's important to point out, however, that muscle glycogen will be fully replenished after 24 hours without any special recovery techniques. Worry about ingesting simple sugars only if you have to race or train again that day. Otherwise, focus on nutrient-dense foods.

### COMPRESSION MAY HELP

Peterson has found ample evidence that compression garments after exercise improve performance in strength and endurance sports, though subjects had to wear the clothing for 24 hours or longer to see the benefits. He also says low-cost ones are just as effective as expensive brand-name options.

### COLD THERAPY

Cold-water immersion and ice vests show limited benefit except when used in the heat, in which case they lead to measurable improvement in subsequent performances.

### COOLING DOWN

A cool-down spin after a hard effort is a standard routine for almost all cyclists. So you may find it surprising that researchers have found little to no recovery benefit.

### IT'S REALLY THAT SIMPLE

After reviewing the various strategies, Peterson has a pretty simple recommendation: "Get good sleep. Compression seems to make a difference. And what you do with your nutrition on a daily basis is going to matter." And, as Phinney says, mental rest is critical. "I really look forward to that time where I'm on my way home and I grab a sandwich from my favorite spot and get a cookie and a soda and I plop down and decompress," he says.

**AT THE BACK** with Dan Wuori

# Hurt so good

**AFTER A GOOD RIDE, I LIKE TO VOMIT.**

Alright, that might have been poorly phrased. It's really not so much the puking I enjoy but, rather, the rides that push me to the limit, the rides that make my lungs burn and my legs cry out for mercy, the rides that leave me heaving for breath and crumpled in a heap. Yeah, that's what I really like.

Cycling plays a unique role in my life—as it might in yours—as the only activity in which I participate at the outer limits of my physical ability. I've never bonked while folding laundry, for example, or rocked a set of PowerPoint slides so hard that I started to wretch. I've never monitored my heart rate at the grocery store or applied chamois cream to protect my delicate nether regions from the punishment of an ergonomic desk chair. No, cycling is different that way.

On the bike, we choose to suffer. In fact, we fetishize it. For proof, look no further than "the Sufferfest," a wildly popular series of training videos designed—if such a thing is actually possible—to make the act of riding a stationary trainer even more unpleasant than it already is. Or witness the sport's seemingly limitless love affair with Jens Voigt, whose "shut up legs" may be cycling's best-known catchphrase since Jan Ullrich's "Nutella? Don't mind if I do!"

When it comes to pushing one's limits, cycling isn't elitist. Sure, the pros may be required to tackle the Alps and cobbles over 150-mile days, but even novices can find opportunities to turn themselves inside out on a bike. I can still remember my first few largely suburban rides of 10, 25, and 50 miles, each of which seemed like a personal Paris-Roubaix at the time. As Greg LeMond famously noted of cycling, "It never gets easier; you just go faster."

Still, for all this talk of suffering, the word has never rung true for me as it relates to time in the saddle. Have I been on some rides that, in the moment, seemed longer or more demanding than I'd anticipated? Sure. But I've yet to return home and swear off cycling as just too agonizing to endure. In fact, it's just the opposite. It's these most challenging rides that I'd jump at the opportunity to try again.

Several years ago I had the chance to ride in the Tour of Flanders sportive, a mass participation ride on the famed cobbles of Belgium. I'm not going to lie—it was one of the most challenging physical activities of my life. But it was also among the most special. As I churned my way up the ragged Oude Kwaremont, I must admit what I felt was not suffering, but some of the purest joy I've ever experienced. And while the day definitely kicked my ass, I'd do it again in a heartbeat. And then once more the next day.

It all makes me wonder if we may be misattributing the concept of suffering, which is defined as enduring pain, distress, and hardship.

As physical pain goes, I can say without hesitation that I've experienced much worse suffering off the bike (occasionally due to injuries I've incurred falling off of them, but I've never counted that as part of cycling). And frankly, it smacks of privilege to describe riding a carbon road bike as an example of undue personal distress or hardship.

Even when it comes to endurance, there are plenty of mundane activities I find far more difficult to withstand than a day on two wheels. They tend to involve wearing a tie and sitting in a windowless conference room. And they only make me want to vomit.

So perhaps we're wise to rethink cycling's somewhat casual use of the word "suffering" to describe what, in reality, are its universal selling points. Maybe we should retire the word altogether and replace it with another term—a term that captures both cycling's challenges and joys. Because, in truth, I've never suffered on a bike.

All that cycling has ever made me is happy. Even when it makes me puke.

*Dan Wuori is currently suffering through his wife's addiction to Gilmore Girls. Follow him on Twitter at @dwuori.*

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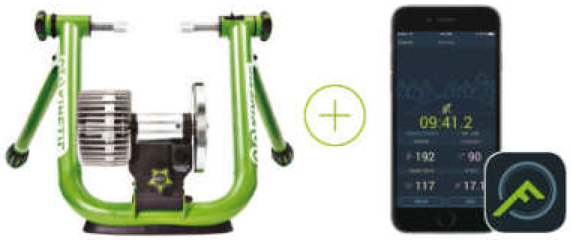

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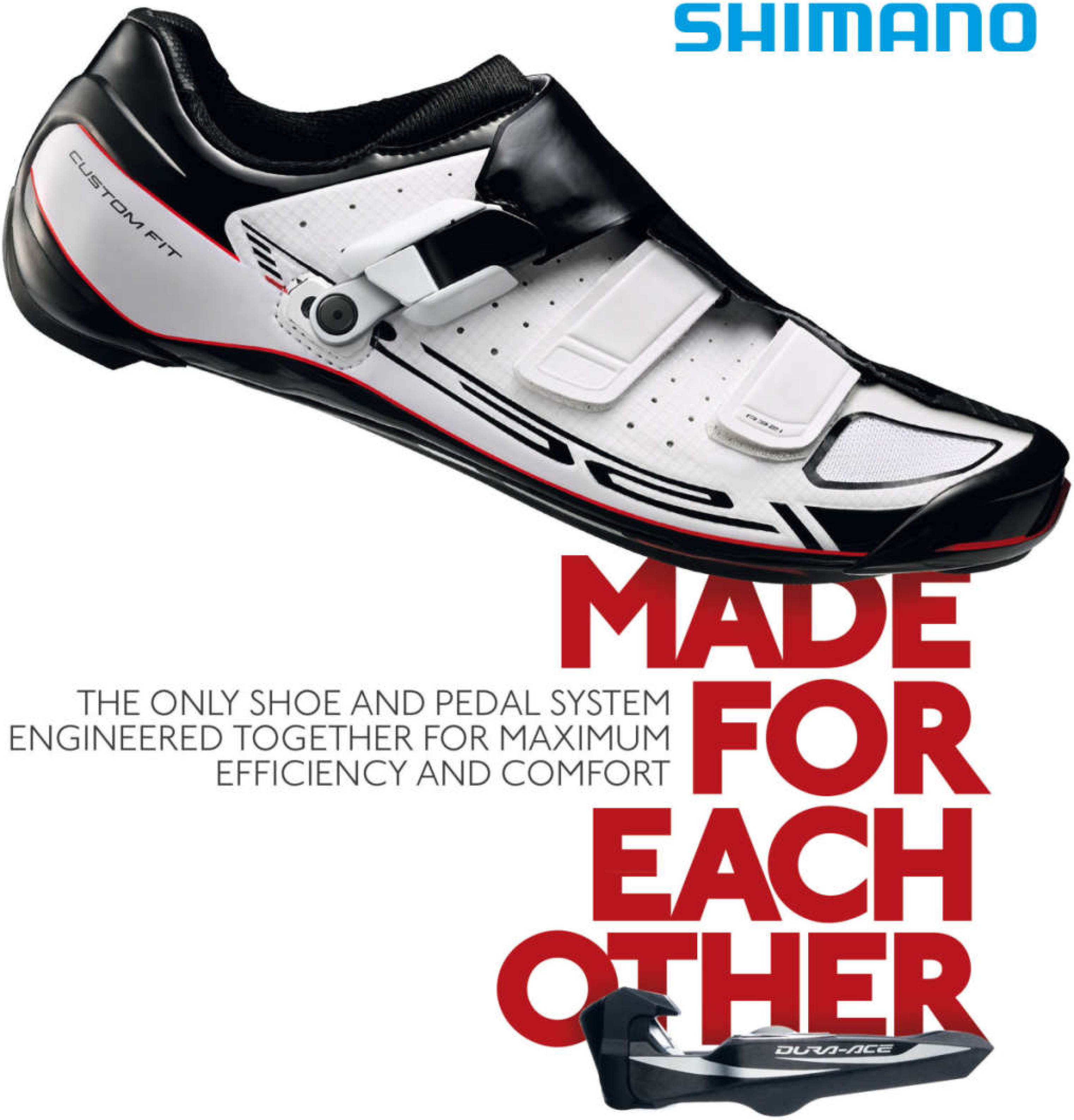

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